

PUBLIC WORKS

Jan.
1957

CITY, COUNTY AND STATE

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Henry A. Haskins is chief of the Maintenance Branch, Bureau of Public Works. In this position he has contributed greatly to the mechanization and improvement of maintenance work. More on page 16.

GRADE-O-MATIC

.....a New Standard of
GRADER PERFORMANCE

- No gear shift — No clutch.
- No engine lugging—No "spinning" drive wheels.
- Automatic torque multiplication as needed.
- Automatic adjustment of engine speed to load.
- Power and weight balanced to produce greatest possible "Push-Power" at the blade.



MODEL T-700 GRADE-O-MATIC, 190 h.p., 40,125 lbs.
MODEL T-600 GRADE-O-MATIC, 140 h.p., 30,420 lbs.
MODEL T-500 GRADE-O-MATIC, 125 h.p., 25,765 lbs.



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*Jim—
We need a
Grader of this type
Let's check into Galion
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C.H.*



THE WORLD'S LARGEST, HEAVIEST AND MOST PRODUCTIVE GRADER.

Galion is now in production on a new motor grader, designated as Model T-700, which they claim is the world's biggest, heaviest, and most productive motor grader. The model T-700 is equipped with Galion Grade-O-Matic drive which utilizes a GM-Allison torque converter and power-shift transmission to achieve ease of operation and performance on the job.

The manufacturer states that the T-700 grader was designed and built new from the ground up, and has been work-tested across the country in all kinds of weather and on all kinds of jobs. Every part of the grader is said to be larger, heavier, stronger, more efficient, and specially designed to obtain tremendous "push-power" at the blade. The total weight of the Galion T-700, with scarifier, is listed at 40,125 lbs., and it is powered by a 190 hp Cummins diesel engine.

The Grade-O-Matic drive on the Galion T-700 is reported to greatly minimize the human element in achieving top grader performance.

The torque converter multiplies the engine torque up to 340% automatically as needed. It also absorbs the load shocks and prevents engine lugging or stalling. A tail-shaft governor on the torque converter adjusts the engine speed automatically to meet all loads or conditions — at any predetermined working or travel speed. The power-shift transmission does the shifting for the operator. All he does is move the fingertip control levers — one for forward-reverse, the other for low-intermediate-high speed. Either shift can be made while moving in either direction. There are 3 speeds forward, 3 reverse, with speeds ranging from creeper to high travel speeds in either direction.

Other features listed as standard equipment on the Galion T-700 grader include a hydraulic shiftable moldboard 14 ft. long, overlay end bits, twelve-ply 16.00 x 24 low pressure tires, four-wheel hydraulic service brakes, a transmission brake for parking, and a foot decelerator for quickly reducing engine speed thus permitting immediate return to travel speed without changing the hand throttle.

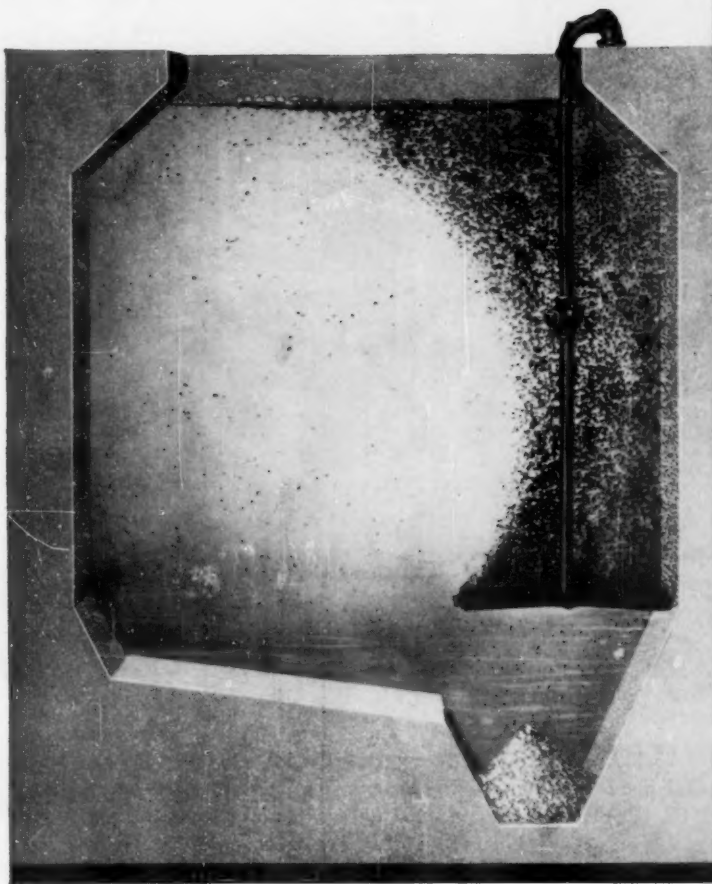
For complete information on the T-700 motor grader, write The Galion Iron Works & Mfg. Co., Galion, Ohio, or any of their distributors.

*O.K. - Looks like the answer
to the Big Jobs coming up.
Jim*

"Chicago"
from

AER-DEGRITTER*

Air Controlled Settling Velocities Independent of Flow



The principle of air controlled velocities was first demonstrated in sewage treatment plants designed by the office of Charles H. Hurd, Consulting Engineer. The Hurd method, using diffuser plates located behind the hopper, was an improvement over the then practiced means of controlling grit tank velocities. The Aer-Degritter* using diffuser tubes located directly above the hopper is, in turn, an improvement on the Hurd method.

The Aer-Degritter* removes grit and sand from sewage through the use of air to effect a controlled velocity of the sewage in the grit tank. The method provides a quiescent zone beneath the air diffusion media to effect a selective deposition of clean grit without organics. There is no need for separate grit washing tanks. Washing and deposition are effected in a single tank.

POINTS OF SUPERIORITY OF THE AER-DEGRITTER*

1. *Relative location of grit hopper and air diffusers.* In the Aer-Degritter* the diffusers are elevated above the tank floor and the grit hopper is directly beneath the air diffusers. This permits greater flexibility of control of tank bottom velocities regardless of volume of sewage flow. It is these bottom velocities that control the deposition of clean grit and fine sand without also depositing organic material. Tests made on grit removed by Aer-Degritters* have consistently shown less than 0.05% putrescibles.

2. *The equipment used to introduce air to the sewage.* The use of Swing Diffusers and Precision Diffuser Tubes permits easy access to the grit hopper and cleaning of the diffuser media without taking the tank out of service.

*The application of the equipment, as well as the equipment itself is covered by U.S. Patents No. 2,532,457, No. 2,144,385, No. 2,328,655 and No. 2,555,201.

always specify "Chicago"



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SEWAGE EQUIPMENT DIVISION

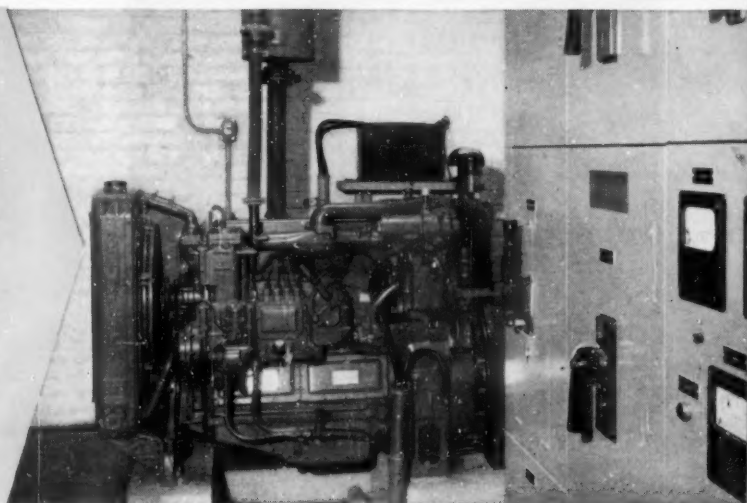
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PROTECTION

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PORT WASHINGTON, N. Y., with a population of 25,000, started construction of its modern sewage disposal plant in 1951. It went into full operation in April, 1952. The system used is of the Bio-filtration type, and the plant consists of two primary clarifiers, two rapid rate trickling filters, two secondary clarifiers and primary and secondary digester tanks. Total capacity is 3,000,000 gallons per day.

Even before the plant was ready, the Port Washington Sewer District installed a Caterpillar D315 Electric Set as standby power. In four years the unit has twice been called on to supply power to the sewage plant. On one occasion a storm cut off power-line current for six hours. The other time a line break interrupted service for three hours. *But the flow of sewage through the plant never stopped.*

Ralph F. Thomas, Chief of Operations, says: "It's good insurance to keep the plant operating efficiently, with no interruption in the treatment during times of power failure."

Any municipality that neglects insuring the operation of its sewer and water systems with dependable standby power

is risking a heavy loss—possibly costing far more than the standby unit. Electric Sets built by Caterpillar are specially designed for this use. They are self-regulating, require a minimum of maintenance, and they're available with either manual or automatic starting, ready to pick up the power load in a few seconds.

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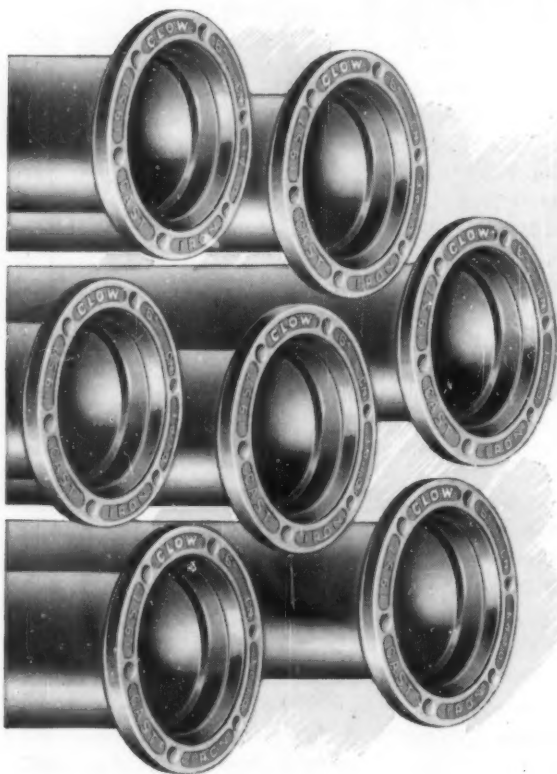
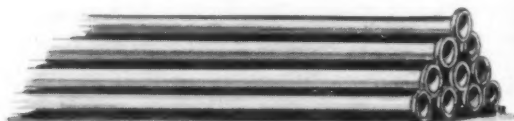
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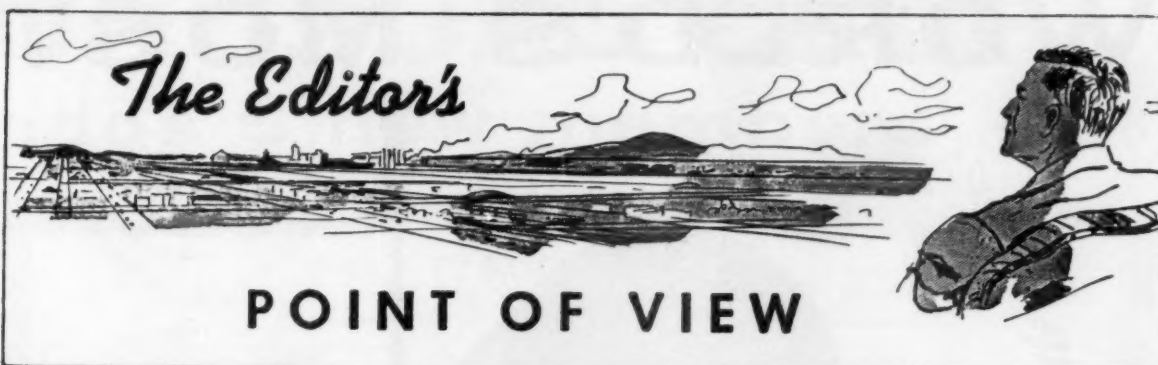
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The Interstate Road Program, Suburban Developments and Public Works Engineering

REAL ESTATE MEN expect that the new Interstate Highway Program will lead to the development of many new suburban housing developments. Whereas many of the previously more desirable close-in sites for home building and for supermarkets have been utilized, the new road system will open many new and more favorable areas. The rapid transportation afforded by these roads will increase the tendency toward country-style living. Resort facilities may be developed in new areas and there will be additional movements of industry outside the cities.

All this adds up to new problems in water supply; in sewerage and sewage disposal; perhaps in treatment of industrial wastes; and certainly in refuse collection and disposal. Also, in these new residential areas, paving, sidewalks, storm drainage, street lighting and power and gas utilities will be needed. It is time all engineers took a new look at all these problems. It seems to us that health department engineers, especially, will need a broad viewpoint to foresee, meet and overcome these conditions; and the old county form of government is going to have to be stretched until it cracks.

Anyway it is time someone started to think seriously about what is going to be done. Engineering is much more valuable if applied preventively and not curatively. Engineering leadership will be surely and sorely needed.

Advancing the Status of Engineers is Important

CERTIFICATION of sanitary engineers is now beginning; at least applications are being received, and it is hoped that the first group of applications will be processed this fall. Certification can be important to the individual, but it is even more important to the profession. The man who receives this recognition should act the part; he should consider himself at all times as representing the high qualifications established for the profession. We would not propose a code of ethics for the certified sanitary engineer; he should be above needing that. A formula for leadership more nearly fills the bill: He should think with

originality, but soundly; he should not hesitate to accept responsibility and to act accordingly; he should be a leader and not merely the technically trained helper who wants someone else to tell him what to do and when to do it.

There has been a lot of work done in carrying the program to its present state. There is still a very large job to be done in making more engineers truly professional men.

A New and Easier Way to Get that Needed Sewage Treatment Plant

FINANCING HAS often been a big problem in getting that much-needed sewage treatment plant. Whether this financial problem arises from a bond limit condition or from voter apathy now makes no difference. Through the services of a large and responsible organization, a sewage treatment plant can be built and leased at cost to the community, with the added provision that, after a term of years, it becomes the property of the city. Sewer rentals will pay the entire bill. The plant can be designed by the city's own consulting engineers and must, of course, be approved by the state sanitary engineer. It can be designed to meet whatever degree of treatment is needed locally; and it can use any desired method of treatment.

Arrangements of this sort have long been needed to help those cities and communities which could not issue the necessary bonds. Now bonding ability can be used to finance other needed improvements. The procedure is based on a long-term lease agreement made through an especially created corporation with sewer rentals (or in the case of a water plant, water charges) used to pay off the cost of the plant over the period of expected useful life.

This plan is especially desirable for industries which are required to provide some treatment for their wastes. As in the case of the community, no initial investment is required and the rental charge, like operating costs, are fully deductible as an operating expense. This is a program that is long overdue. Widely used, it can be of tremendous benefit in reducing the problem of stream pollution.

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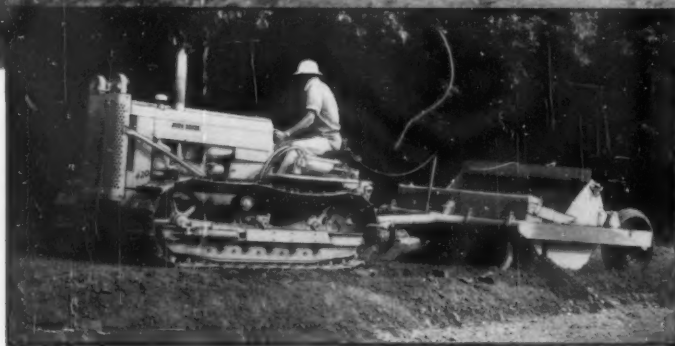
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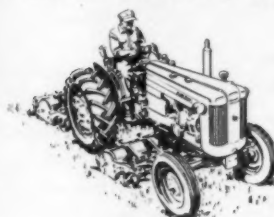


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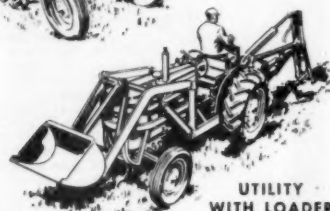
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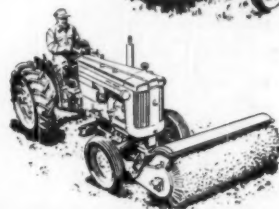
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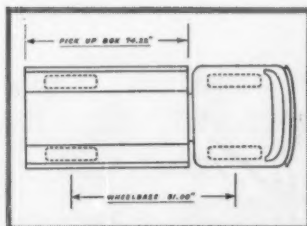
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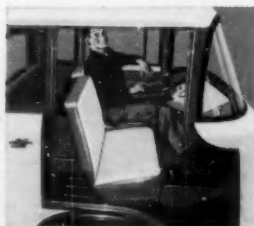
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'Jeep' / *Forward Control*

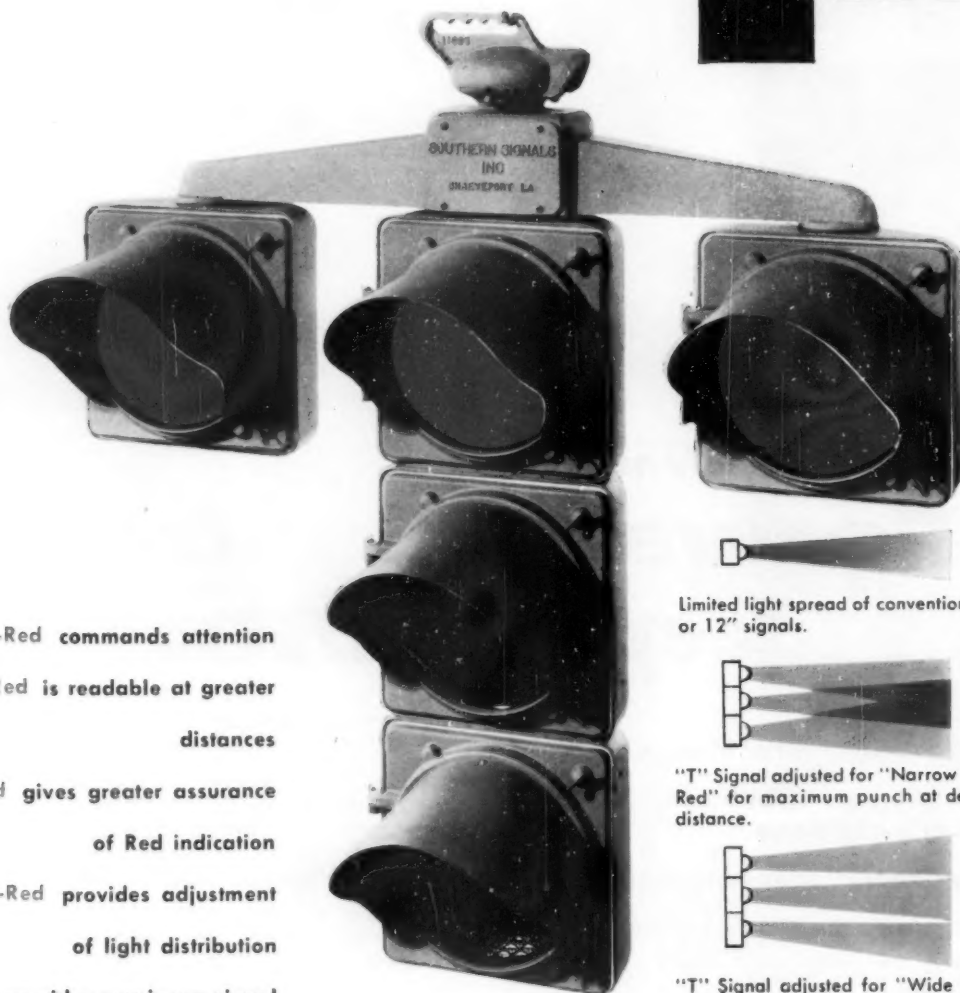
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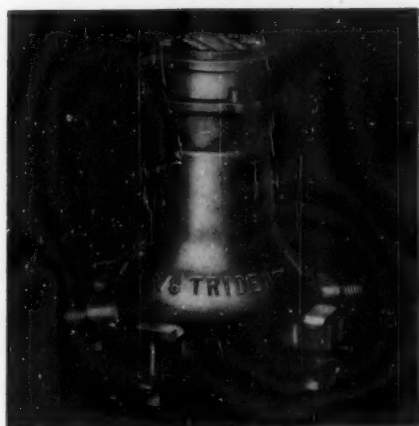
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Trident meters are built to hold accuracy longer, so you receive all the revenue you should. They're built to be easier to repair, so your shop time and expenses are cut down. They're designed so that the newest parts fit the oldest meters . . . simplifying your repair

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For more than 50 years, Neptune has built fine meters designed to earn more and cost less. Many 50-year-old Tridents are still in service . . . perhaps in your own community . . . living proof that the Tridents you buy today will be a credit to your water system for many long years to come.

NEPTUNE METER COMPANY

19 West 50th Street • New York 20, N. Y.

NEPTUNE METERS, LTD.

1430 Lakeshore Road • Toronto 14, Ontario

Branch Offices in Principal
American and Canadian Cities.



...for treating domestic and industrial wastes

18-month test shows HI-CONE system operating costs are 44% less! *than air diffusion system*

- **TESTS PROVE LOWER POWER COSTS!**
- **LOWER MAINTENANCE COSTS!**
- **BETTER EFFLUENT**

In the selection of sewage treatment equipment, the two most important factors are operating cost and effluent quality.

These figures from the annual report of the Manchester, England, Rivers Department, *prove* the superiority of the Hi-Cone! They're based on the operation of activated sludge plants (including a Hi-Cone System and a diffused air system) under strictly comparable conditions over a period of 18 months. Manchester is a pioneer in treatment by the activated sludge process, having first conducted experiments and tests in 1913.

Hi-Cone's power consumption was lower! Horsepower demand per million gallons treated per 24-hour day for the Hi-Cone System was 34.9% lower than the air diffusion system.

Hi-Cone's total operating costs were lower! Relative costs per million gallons treated were 42.1% lower than the air diffusion system.

Hi-Cone's effluent was better! The B.O.D. reduction was 26% greater; the suspended solids removal was 5% greater than the air diffusion system.



Use this coupon to ask for detailed information

Please send the following descriptive literature on the Hi-Cone:

- ☐ Cost and operating reports ☐ Report of article, "U. S. and British engineers agree on the Hi-Cone System"
- ☐ Hi-Cone engineering data

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Note: Recordak is an authorized Verifax dealer . . . offers prompt nation-wide sales service through its 35 Branch offices in principal cities.

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More than 400 four-page instruments can be filed on a 100-ft. roll of 16mm film for fast "fingertip" reference, or low-cost storage in security areas.

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DURAJOINT®

Polyvinylchloride=PVC **WATERSTOPS**

ADVANTAGES

- Resistant to extreme waterhead pressures
- Tensile strength of not less than 1900 lbs. per square inch
- Superior holding strength... elongation ability of more than 350%
- Effective temperature range of -54°F. to +176°F.
- Chemically inert... resistant to acids, alkalis, weather, chlorinated water, oil, fungus, etc.
- Quickly, easily spliced "on-the-job" by merely applying heat and holding ends together... requires no welding or vulcanizing equipment
- Available in a type and size to meet the requirements of any particular climatic condition and head of water
- Supplied in lightweight, easy to handle 50 ft. coils... withstands abuse without damage

Have you compared "DURAJOINT" with your present waterstop materials? If so, you have already found out that *only* "DURAJOINT" offers *all* of the following important features:

BEST MATERIAL... "DURAJOINT" is extruded from a specially compounded polyvinylchloride (thermo-plastic) material that will outlast the useful life of the structure it's used in.

BEST DESIGN... "DURAJOINT'S" special longitudinal ridges insure the distribution of critical pressures and enhance the holding power. The hollow center bulb assists in providing for extreme elongation with full recovery.

STRONGER... "DURAJOINT'S" extreme elasticity and excellent tear resistance allow it to successfully handle movement of masses of concrete without being sheared.

ECONOMICAL... "DURAJOINT" may be installed at a substantial savings in material and labor costs over other waterstop materials... easily installed by unskilled labor.

"DURAJOINT" enjoys national distribution through the outlets of Tecon Products Inc. in the 11 western states and W. R. Meadows, Inc. in the other 37 states of the mid-western, southern and eastern portions of the United States. Write today for complete information and name of your local distributor.

**NATIONALLY
DISTRIBUTED!**

A PRODUCT OF ELECTROVERT

Available in your area through...

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INC.**

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**W. R. MEADOWS,
INC.**

24 KIMBALL STREET
ELGIN, ILLINOIS



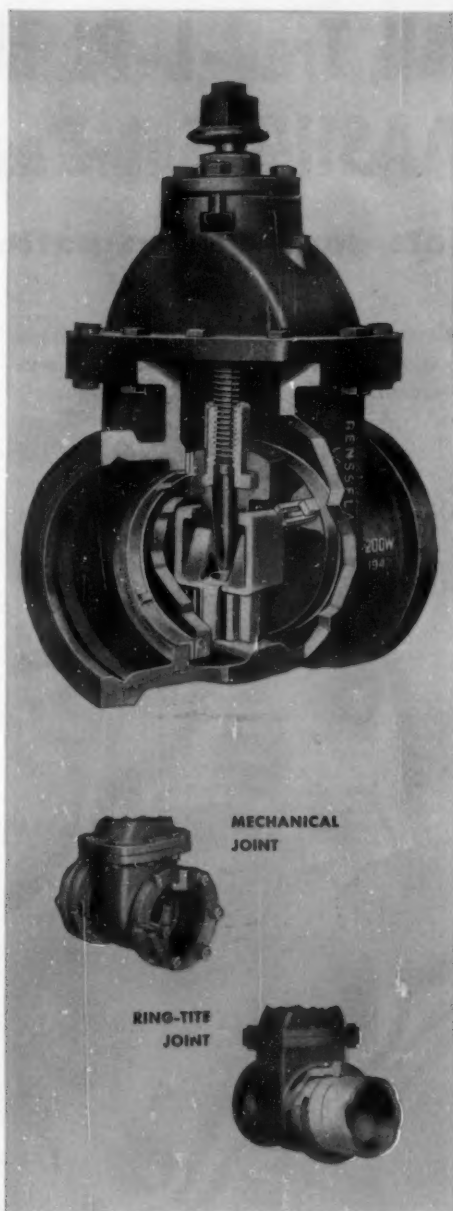
LEADER IN PUBLIC WORKS

Henry A. Radzikowski, Chief of the Maintenance Branch of the Bureau of Public Roads, has been a leader in the development of high standards for the maintenance and operation of Federal-aid highway systems; in the application of sufficiency ratings for scoring the condition, safety and service of these roads, in the development of balanced maintenance equipment fleets; and in the use of radio-telephone communications, electronic computers and other modern engineering devices in the highway field. His article in this issue points out some of the factors where mechanization will reduce the costs of maintenance and keep our highway system in the best possible condition.

He is a Bostonian by birth and was graduated from Tufts College with a degree in Civil Engineering. He also has a law degree from Georgetown University and is licensed to practice law as well as being a licensed professional engineer.

Mr. Radzikowski joined the Bureau of Public Roads in 1928 on highway construction engineering. Later he was Bridge Design Engineer on the Mount Vernon Boulevard, Virginia; Location Engineer on the Blue Ridge Parkway, Virginia; on long-range highway planning surveys in West Virginia, Kentucky, Wyoming and North Dakota; and since 1934, Highway Maintenance Engineer.

In addition to the development and administration of better maintenance techniques for the Federal-aid highway system, he is engaged in many other activities, being Safety Officer of the Bureau and an engineering consultant to the ARBA Task force to study the needs for the Interstate Highway Program. He is secretary of the Maintenance and Equipment Committee and the Radio Committee of the AASHTO, chairman of the Highway Maintenance Cost Committee and a member of the Maintenance Department of the Highway Research Board.



RENSSELAER
A. W. W. A.
VALVES



It costs more to dig up a valve than it does to be sure that the valve is right in the first place. Rensselaer A.W.W.A. Valves have been giving satisfactory service in hundreds of cities for many years, and there are many "reasons why."

The well known Rensselaer wedge mechanism, for instance, presses the gates firmly against the valve seats on closing, but on the first turn of the opening, the wedging mechanism is released and the gates are free.

The generous use of solid bronze, the rust proofing and the simplicity of servicing make for long life and low maintenance. All parts are interchangeable and accurate because of the precision casting and machining.

Only two types of valve ends are shown. All types are available together with tapping valves and other accessories.

The names, Ludlow and Rensselaer mean the same today that they have during your lifetime. The desire to serve the Water Works Field in person—in research and design and in prompt delivery of original equipment and spare parts for all products has not changed.

*Ask for
Bulletin "A"*



LUDLOW & Rensselaer

LUDLOW RENSSELAER **VALVES & HYDRANTS**

Since 1861 THE LUDLOW VALVE MANUFACTURING CO. Troy, N. Y.

27

Seaman-Andwall Trav-L-Plants Uniformity in AASHO Sub-Base

Global interest shown as AASHO sets construction pattern

Highway officials, engineers and contractors from all parts of the world have been watching the most rigidly controlled road construction experiment ever attempted. AASHO engineers demanded undeviating uniformity in the sub-base of every test section. All equipment had to prove its performance beyond question before acceptance. And all equipment had to be absolutely identical. After competitive test with other mixers, Seaman TRAV-L-PLANTS were selected to do the mixing, the blending of soil particles to attain the specified 95% densities and to bring the moisture content of the fill to optimum. 27 TRAV-L-PLANTS, all equipped with pumping equipment, volumetric meters, spray bars, underbody scarifiers and power steering kept the moisture increment within the tight 2% tolerance demanded.

The stiff clay used in the sub-base stabilization made the job of fast, uniform mixing impossible in the initial experiments made with other equipment. The SEAMAN-ANDWALL TRAV-L-PLANT, on the other hand, demonstrated great superiority in the attainment of the exacting uniformity.

Each TRAV-L-PLANT towed its own water supply because tank trucks were not allowed on grade. 1000 gallon wheel mounted tanks were attached

AASHO TESTS PATTERN FUTURE HIGHWAY METHODS

Sub-grade stabilization, once the most neglected phase of modern highway construction, has come of age. The most recent proof of this comes from LaSalle, Illinois, center of the most ambitious experimental highway construction programs in the nation's history. The American Association of State Highway Officials; all 48 states; the territories of Hawaii, Puerto Rico and the District of Columbia and the Highway Research Board are participating in the construction of this significant test facility. The AASHO test road will be in the nation's road building spotlight for many years to come. The painstaking control exercised by AASHO engineers; the precision and perfection of new road building methods and the high speed equipment that was used, will certainly be studied and specified on many thousands of miles of new construction. The techniques and operations adopted at the AASHO test road may well become standard operating procedure on all roads of the future.

SEE THE ROAD SHOW

BE SURE TO SEE THE SEAMAN-ANDWALL EXHIBIT
AT THE ROAD SHOW, SECTION A, BOOTHS 320 AND 323



Achieve Unparalleled Stabilization Tests

for nation's highway program

at the side of the TRAV-L-PLANTS by an outrigger device.

SEAMAN-ANDWALL TRAV-L-PLANTS through their superiority established in the gigantic AASHO experiment have again won recognition and approval as standard equipment in base and sub-base stabilization in the National Highway Program.

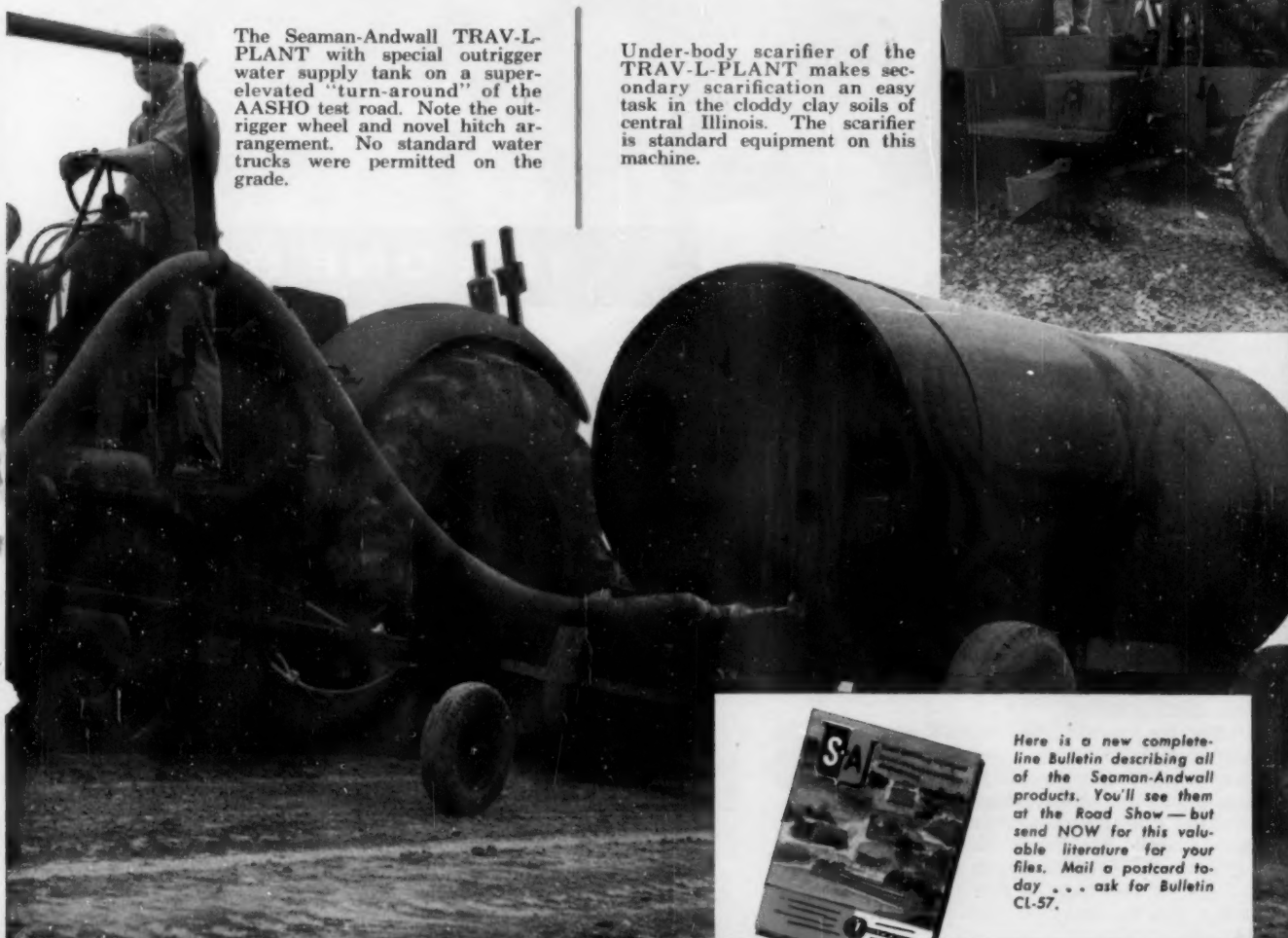
Successful bidders for the sub-grade work were the S. J. Groves and Sons, Co. of Minneapolis and the Arcole Midwest Construction Co. of Skokie, Illinois.

The Seaman-Andwall TRAV-L-PLANT with special outrigger water supply tank on a super-elevated "turn-around" of the AASHO test road. Note the outrigger wheel and novel hitch arrangement. No standard water trucks were permitted on the grade.

Under-body scarifier of the TRAV-L-PLANT makes secondary scarification an easy task in the cloddy clay soils of central Illinois. The scarifier is standard equipment on this machine.



A caravan of four TRAV-L-PLANTS on the straightaway of the AASHO test road. It is high production like this that completes the sub-base stabilization work on time. A total of 27 such units were on the job.



Stabilizing the World
SEAMAN-ANDWALL
CORPORATION



Here is a new complete-line Bulletin describing all of the Seaman-Andwall products. You'll see them at the Road Show—but send NOW for this valuable literature for your files. Mail a postcard today . . . ask for Bulletin CL-57.

A Division of American-Marietta Company
Dept. R-227
MILWAUKEE 1, WISCONSIN

Announcing the all new $\frac{4}{10}$ yard, $8\frac{1}{2}$ ton 85A "QUICK-WAY"...



When you can make money with a small outfit, think how much more money you can make with the husky "QUICK-WAY" 85A. Why be satisfied with a 6 or 7 tons in the $\frac{3}{8}$ yard class when you can get $8\frac{1}{2}$ tons in the $\frac{4}{10}$ yard "QUICK-WAY" 85A—and for approximately the same price.

The new "QUICK-WAY" 85A has more Big Shovel Features than any other in the small shovel field.


It has been engineered to meet rugged, heavy-duty specifications with fewer moving parts. The power train is oversize, all shafts are splined for easy maintenance. Extra strength has been built in the machinery frame and gantry for greater lifting power.

For the owner, the "QUICK-WAY" 85A is a quality machine, designed to deliver more efficient performance per pound and per dollar than many more costly machines.

For the operator, the "QUICK-WAY" 85A has been simplified for easy, economical maintenance of all parts. It operates smoothly and quietly for maximum production and minimum operator fatigue.

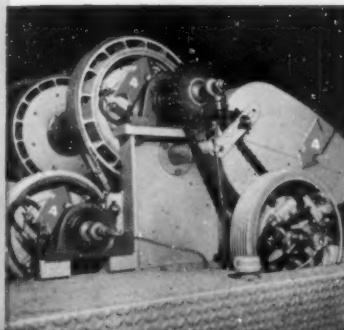
You owe it to yourself to see the new "QUICK-WAY" 85A before you buy any shovel at any price. See your distributor for a demonstration and get the real facts on how you can make more money with the husky "QUICK-WAY" 85A.

"QUICK-WAY"

A  Subsidiary

TRUCK SHOVEL CO.
DENVER, COLORADO

THE ONE SMALL



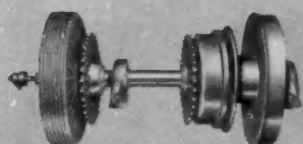
1. **SIMPLIFIED CHAIN AND GEAR DRIVE** for efficient, quiet operation—the combination of roller chains and precision machined gears gives efficient transmission of power through the minimum number of moving parts. This simple, efficient design provides quiet, low-maintenance operation. Stand. engine 47 HP @ 1800 rpm.
2. **MAIN HOIST AND HAUL BACK DRUMS**—are mounted on a single, accessible shaft with sealed anti-friction bearings. Two-piece cast laggings are easily changed for different operations. Large clutch and brake drums have separated surfaces with louvers for cooling.
3. **LARGE SWING DRUMS** are ribbed for cooling—and are mounted on a king-sized horizontal swing shaft. Swing brakes are optional. Vertical swing shaft is mounted in double anti-friction bearings at top with an anti-friction needle roller bearing at bottom. One-piece, bonded brake linings provide more surface for smoother, cooler operation.
4. **OVERSIZE CLUTCHES** have more surface—for smoother, positive action. All clutches are hydraulically operated for easy, sure application of power. Hydraulic clutch controls operate with minimum effort and give the operator the feel of the load at all times.

... and the "QUICK-WAY" all new CRAWLERS 85 AC & 105 AC



Now you can get the "QUICK-WAY" 85A and 105A on a crawler! You get the same "QUICK-WAY" Big Shovel Features on the crawler that gets to its job, stays with the work, even in close, restrictive quarters. The new "QUICK-WAY" Crawler has independent travel—forward and reverse speeds of 7/8 miles per hour in low range and 1-3/4 miles per hour in high range. It is now available in 16" crawler shoes (5.1 psi ground pressure), 24" crawler shoes (3.5 psi ground pressure), and 32" crawler shoes (2.5 psi ground pressure). Width of 95" has been especially designed for hauling on trailers.

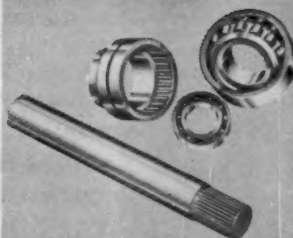
SHOVEL WITH BIG SHOVEL FEATURES



POWER UP AND DOWN BOOM HOIST IS STANDARD—A simple precision design makes safe, sure operation. A one-piece cast steel unit contains pawl teeth, windlass and brake drum. The cable end is located in an easily accessible place for quick attachment change-over.



ONE-PIECE FLOOR FRAME, HEAVY DUTY SWING TABLE GEAR AND HOOK ROLLERS—Floor frame electric welded in jig, then all bearing mounts machined at one time for precision alignment. One-piece, cast steel swing table gear. Four hook rollers distribute load.



ALL SHAFTS SPLINED, ALL ANTI-FRICTION BEARINGS—All shafts extra large for maximum strength, precision splined for easy maintenance. Anti-friction bearings used on all high-speed, continuous rotating shafts and drums. All shaft bearing surfaces are precision ground.



MACHINERY HOUSING DESIGNED FOR COMPLETE, EASY ACCESS—to all machinery. New feature is an automobile hood-type cable trough cover that lifts high for complete access to central machinery. New cab has 360° vision through removable safety-glass windows.

THE MOST COMPLETE LINE...WITH 5 MODELS IN THE SMALL SHOVEL FIELD!



105A & 105AC
5/10 YD., 10½ TONS



125A
6/10 YD., 12½ TONS

with the famous money-making line of
"QUICK-WAY" attachments for all models.



Get these important books . . . free!

- ☐ The new catalog on the "QUICK-WAY" 85A and 85AC Crawler.
- ☐ The new catalog on the "QUICK-WAY" 105A and 105AC Crawler.
- ☐ The new catalog on the "QUICK-WAY" 125A.

"QUICK-WAY" TRUCK SHOVEL CO., Dept. 87
2401 East 40th Ave., Denver 5, Colorado, U.S.A.

Name.....Title.....

Company.....

Address.....

City and State.....



Ford Industrial Loaders are used in Indiana the year 'round. At left, dirt and trash from a grading and ditching job is quickly cleaned up and loaded. In winter, 144 Ford Tractors and loaders are spotted at ice-control stockpiles throughout the state. Local road crews drive in, load up and are back on the highway in a matter of minutes.



You see more **FORDS**

How 180 Ford Tractors cut maintenance costs on Indiana highways

Three years ago the State Highway Department of Indiana switched from single-purpose equipment to multi-purpose Ford Tractors and Industrial Equipment for maintenance work. After a year of testing on a contract basis, the Department purchased 108 Fords in 1955, and 72 in 1956. The result has been better and more economical maintenance of Indiana's 12,000-mile highway system. These Indiana officials explain why:



"We've cut our mowing costs in half!"
reports Virgil W. Smith, Chairman,
Indiana State Highway Commission

"Like most states, we find that mowing is our most expensive operation. Hilly terrain in sections of Indiana adds to our mowing costs. Since we put Ford Tractors and Rotary Cutters on the job we've cut mowing costs in half . . . actually found that Ford Rotary Cutters outmow conventional sickle-bar types by 3 to 1!"

"Operator training is no longer needed,"
says Al Magenheimer, Personnel Director

"Ford Tractors are so easy to operate that we've eliminated operator training. We've also greatly reduced our maintenance accident rate, even with an increase in highway traffic. With a Ford and Rotary Cutter, the operator is completely off the highway when he makes his first cut."



"We have many sources for emergency parts,"
explains Harold Mason, Superintendent
of Equipment

"Each of our 36 sub-district garages has 5 Ford Tractors, 4 Rotary Cutters, 5 Industrial Loaders, 1 Post Hole Digger and 2 Rear Blades. With this equipment our Ford Tractors are never idle. They mow in the summer, load snow-and-ice-control materials in the winter, dig guard-rail post holes, and grade berm any time. Parts and service availability couldn't be better."



Indiana is one of many states that have cut maintenance costs by switching from expensive, single-purpose equipment to low-cost, multi-purpose Ford Tractors and Industrial Equipment. Find out how your state, county, township or municipality can do the same thing. Call your local Ford Tractor dealer, or write direct to: Tractor and Implement Division, Ford Motor Company, Birmingham, Michigan.

By standardizing on low cost, multi-purpose tractors and equipment, the Department handles a wide variety of maintenance jobs. For example, a Ford and rear blade maintains berm as shown at left. The blade can be quickly replaced with a post hole digger and the same tractor and operator are ready to dig holes for guard-rail posts. The Department also uses a big fleet of Ford cars and trucks . . . actually more Fords than any other make!

...because they save more money



Use Northern Gravel for Rapid Sand Filter



The new Northeast Station in the City of Detroit, which is scheduled for completion in 1956, is one of the major projects included in the water department's expansion program. The Northern Gravel Company furnished 120 carloads of filtering materials for the 48 rapid sand filters incorporated in this plant.

Filter Sand Specifications

are carefully laid out. The Effective Sizes and Uniformity Coefficients used by Consulting Engineers and also recommended by the American Water Works Association are the result of long years of research and experience.

The Northern Gravel Company is equipped to give you prompt shipment whether it be one bag or many carloads, exact to specifications. Filter sand can be furnished with any effective size between 0.35 MM and 1.20 MM.

Chemical Quality

of the filter sand is also important. It must be hard, not smooth, and free of soluble particles. This requires perfect washing and grading facilities. We have every modern device for washing, drying, screening and testing.

Filter Gravel

supporting the Filter Sand Bed must be, in turn, properly graded to sizes calculated to support the Filter Sand, and be relatively hard, round and resistant to solution.

Northern Gravel has no equal in facilities and our reserves of both sand and gravel are inexhaustible. Northern Gravel Company has been in business over 40 years. We guarantee uniformity of products and our records enable us to duplicate your requirements on short notice. Our location is central and we have commodity rates in every direction.

Northern Gravel Company
Muscatine, Iowa

Box 307

Ph.: Amherst 3-2711

PROFESSIONAL OPPORTUNITIES

An Experienced Sanitary Engineer is Available

A widely known sanitary engineer with design, operating and sales experience in the water, sewage and industrial waste treatment fields, desires a connection with a consulting sanitary engineering firm. His present work involves an undesirable amount of travel. His age is 62 and he is in excellent physical condition. His experience has included treatment plant design (water, sewage and industrial waste); supervision of operation; and more than 15 years in his present position. He is personally well-known to and recommended by the Editor of Public Works. Write to Box 1-X, Public Works Magazine, 200 South Broad St., Ridgewood, N. J.

Sales Personnel Wanted

District Sales Representatives are needed by a leading manufacturer of tractor attachments for territories in the northwestern and southwestern parts of the United States. Duties include contacting distributors of heavy earth moving machinery and training distributor personnel in selling servicing, operating and promoting the manufacturer's equipment. Starting salary \$400 plus car or car allowance, traveling expense and additional incentive plan. Write Box 1-7, Public Works, 200 South Broad Street, Ridgewood, N.J. Letters will be forwarded without acknowledgment.

Commissions for Young Engineers in The Army

The Army is offering a limited number of reserve commissions to graduates in civil, sanitary and chemical engineering. The announcement received in this office is written in highly technical gobbledegook, with plenty of hedging, in good Army style. A careful interpretation, based on correspondence and conversations, indicates that this program is intended largely to reach engineers who are about to graduate and are liable to military service. Your Editor some time ago pointed out the desirability of providing some means for utilizing these skilled men as officers, working in their specialties, rather than as enlisted men. The steps taken by the Army are excellent



DRILLING GAS MAINS UNDER PRESSURE: Jaeger "125" rotary compressor powers a Mueller C1-36 Drilling Machine, drilling a 10" main under pressure, preparatory to

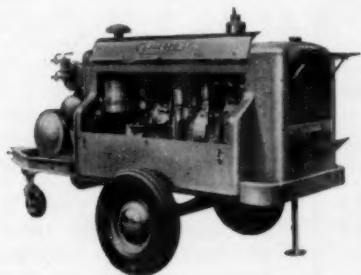
installing line stopper plug. The unfluctuating pressure maintained by the Jaeger rotary insures a uniformly accurate cut, vital for proper seating of the inserted plug.

Jaeger Rotary maintains constant pressure at slower operating speeds

Jaeger compressors produce the same volume of air as other rotaries at 100 to 250 rpm slower engine speeds. Full load speed of a "125" is only 1700 rpm, of a "600", just 1650. This higher Jaeger efficiency saves horsepower, saves fuel, saves engine and compressor wear.

Instantaneous air delivery and smooth, stepless speed modulation enable a Jaeger rotary to maintain 100 lbs. constant pressure under all normal operating demands.

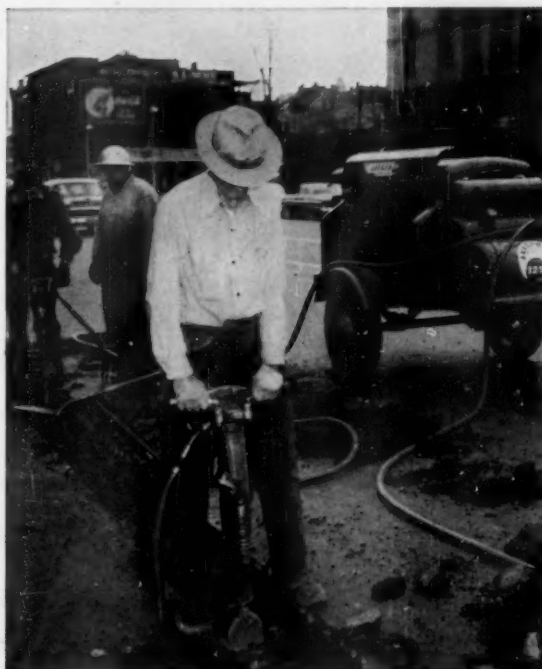
8-hour fuel tanks, full size tool boxes and retractable pneumatic tired dolly wheel are standard on all 2-wheel models. For complete data or demonstration, ask your Jaeger distributor or write for Catalog JCR5.



JAEGER "250" — biggest rotary compressor on two wheels. 4-wheel units to 600 cfm.

THE JAEGER MACHINE COMPANY
400 Dublin Ave., Columbus 16, Ohio

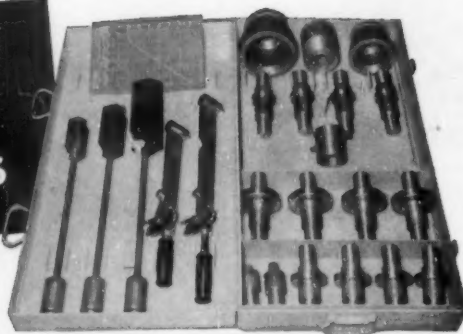
PUMPS • CONCRETE MIXERS • TRUCK MIXERS • PAVING MACHINES



FAST TRENCHING: Jaeger "125" maintains full pressure in two #25 Thor breakers. Speeds trench cutting and other work with power tools.

"IN-PLACE" SHEAR READINGS

**FAST, ACCURATE,
WITH NEW ACKER
VANE TEST KIT!**



The Ackers Vane Shear Test Kit has everything needed to obtain fast, accurate, "in-place" shear readings to depths of 100 feet!

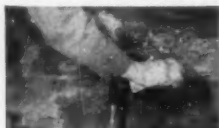
It's easy to use and provides accurate soils information at low cost! For ease in carrying, the entire set of tools are packaged in a handy steel kit.

Write today for prices and free illustrated folder 700! PW

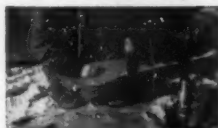
Assemble the Vane
to the Rod!



Insert in Casing and Apply
Pressure to the Torque Wrench!



Consult the Torque Chart
for Accurate Reading!



ACKER DRILL CO., INC. 725 W. Lackawanna Avenue
Scranton, Penna.

a complete line of Soil Sampling Tools, Diamond and Shot Core Drills,
Drilling Accessories and Equipment

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A Tradition of Friendly Hospitality
METropole
Sixth and Walnut
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RATES \$3.50
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Right in the heart of everything—for business or pleasure. 400 cheerful rooms, many air-conditioned... nationally famous food and beverages... excellent service... our bid for your contentment...

Free overnight parking for transient guests.

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400 fine rooms from \$4

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HOTEL FORT WAYNE \$4
300 delightful rooms from \$4

COLUMBUS, O.
HOTEL BROAD-LINCOLN \$3.50
150 choice rooms from \$3.50

MIAMI BEACH
the **SOVEREIGN** HOTEL
On the Ocean at 44th Street

**What you should
know about**

SOIL ENGINEERING

by LEO J. RITTER, JR.

SOIL engineering is the practical application of engineering principles to problems involving the use of soil, either in its natural condition or as a construction material. In this authoritative booklet all phases of soil engineering are treated in simple, easily understandable language. Full information is provided on basic soil properties, classification systems, field and laboratory tests, frost action and compaction. Liberally illustrated and containing many special charts and graphs to assist the engineer in his work.

ORDER from Book Department, **PUBLIC WORKS**, 200 So. Broad St., Ridgewood, N. J. Only \$1.00 per copy.

and worthy of congratulations. The vacancies presently announced number 50 and are in the Medical Service Corps. Application should be made to the Medical Section of the Headquarters of the Army area in which the applicant resides or is in study. Applications may be made as far as four months in advance of graduation. When commissioned, the officer must accept an active duty call. Other appointments, with active duty, are also available to more experienced engineers.

Highway and Traffic Engineering Conferences

The 43rd annual Illinois Highway Engineering Conference will be held at the University of Illinois on February 26-28, 1957. For full information write John W. Hutchinson, 303 Civil Engineering Hall, Urbana, Illinois. The 9th annual Illinois Traffic Engineering Conference will be held February 28 and March 1, 1957 at the same place. Director of this conference is John E. Baerwald, 401 Civil Engineering Hall, Urbana, Illinois.

Instrument Short Course

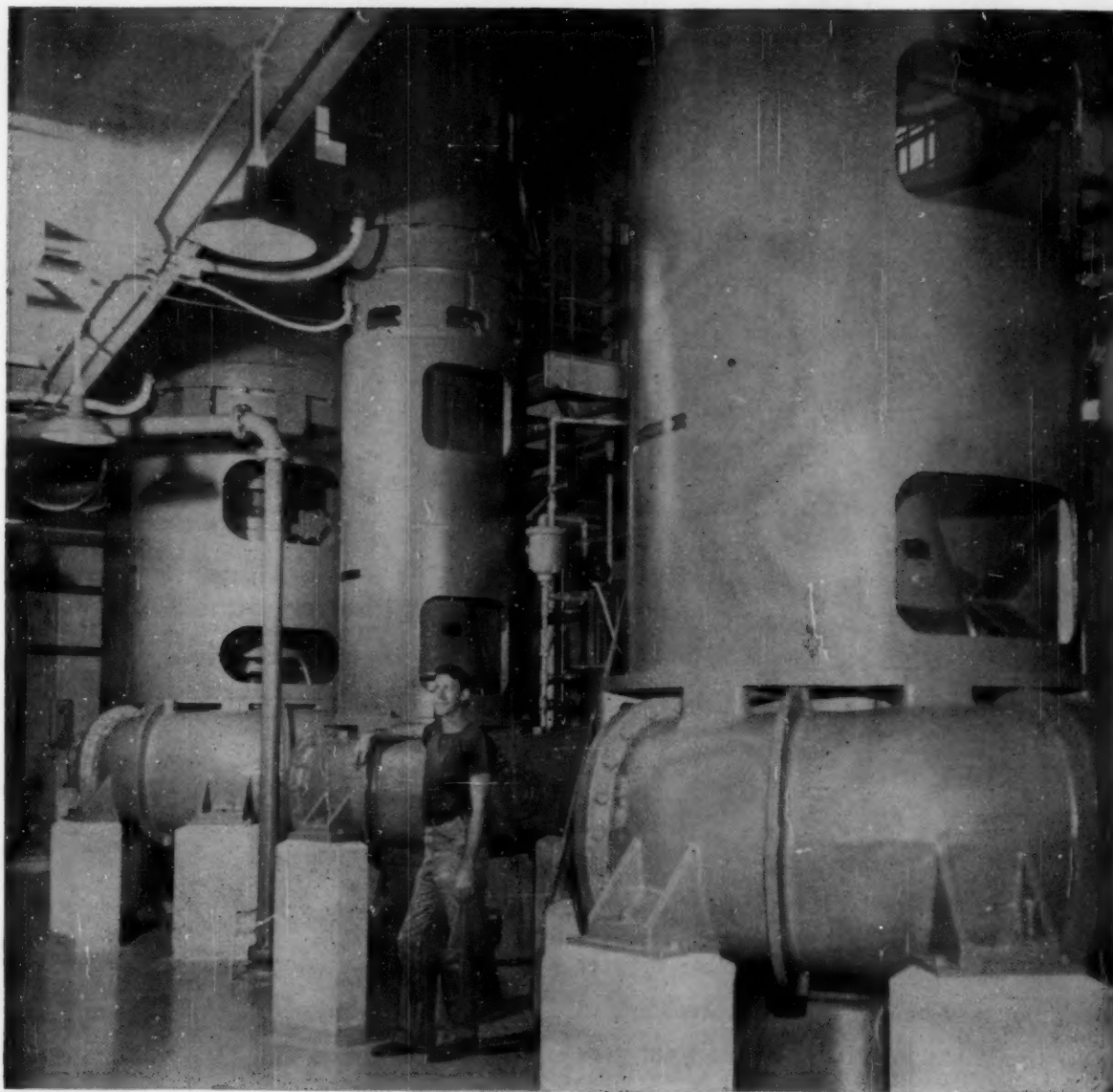
The annual instrument short course, sponsored by the Los Angeles Harbor Junior College and the Southern California Meter Association will be held at the college Jan. 31 and Feb. 1. The college is located at Wilmington, Calif. The course will cover basic fundamentals, measurement, application and advance techniques of pneumatic and electronic instruments. Thomas H. Ponton, 640 Fillmore St., Fillmore, Calif., will furnish further information.

Conference on High Speed Computers

Louisiana State University is making plans for its fourth Conference on High Speed Computers to be held on the University campus at Baton Rouge March 5 through 8, 1957. It is open to engineers, chemists, physicists, office managers, and other users, and attendance is not restricted to Louisiana residents. Information from Frank T. Carroll, Jr., Assistant to the Dean, College of Engineering, Louisiana State University, Baton Rouge, La.

Texas PE Society

Texas Society of Professional Engineers will hold its annual convention in San Antonio at the Hilton Hotel, January 24, 25 and 26.



24", 30", and 36" Fairbanks-Morse "Angleflow" pumps in Tampa's Krause St. station. Consulting Engineer—Greeley and Hansen, Chicago.

Master Plan for Tampa

To eliminate a serious bay pollution problem, Tampa has expanded its sewage treatment and disposal facilities by doubling the area served and connecting a 78% increase in population. The \$22 million investment includes a 36 m.g.d. treatment plant, six new pumping stations with 27 new Fairbanks-Morse sewage pumps. There are pumps in the Fairbanks-Morse line to move

any magnitude of municipal water supply at any appropriate pressure, and other pumps to meet ordinary or unusual problems of wastes treatment and disposal. A Fairbanks-Morse hydraulics engineer will be happy to work with your consulting engineer in specifying the right pump for your specific job. Fairbanks, Morse & Co., Dept. PW-1, 600 So. Michigan Ave., Chicago 5, Ill.



FAIRBANKS-MORSE

a name worth remembering when you want the BEST

PUMPS • SCALES • DIESEL LOCOMOTIVES AND ENGINES • ELECTRICAL MACHINERY • RAIL CARS • HOME WATER SERVICE EQUIPMENT • MOWERS • MAGNETOS

simple shifting

means



- 1 proper use of all available gear ratios
- 2 easier handling rigs; better maneuverability
- 3 reduced driver fatigue; safer operation

Eaton 2-Speed Axles not only let drivers select from TWICE the conventional number of gear ratios, but they make these ratios available at finger touch. Result: drivers use the right gear ratio for every road and load condition; engines operate in their most economical speed range; stress and wear are reduced on all power-transmitting parts. Trucks cost less to operate and maintain; last thousands of miles longer; and bring higher allowances at trade-in time.

EATON *2-Speed Truck* AXLES



More than Two Million
Eaton Axles in Trucks Today.
For complete information,
see your truck dealer.

EATON

AXLE DIVISION
MANUFACTURING COMPANY
CLEVELAND, OHIO



PRODUCTS: Engine Valves • Tappets • Hydraulic Valve Lifters • Valve Seat Inserts • Jet Engine Parts • Hydraulic Pumps
Motor Truck Axles • Permanent Mold Gray Iron Castings • Forgings • Heater-Defroster Units • Automotive Air Conditioning
Fastening Devices • Cold Drawn Steel • Stampings • Gears • Leaf and Coil Springs • Dynamatic Drives, Brakes, Dynamometers

Introducing

NEFMATS

For **BETTER TRAFFIC CONTROL!**



STOP

★ Double High Contrast

★ Brightly Colored ★ Tough, Flexible Plastic

★ One-Piece Traffic Letter Mats

★ Reflective ★ Quickly Installed



**dramatic
proof!**

NEFMATS are made of the same highly durable plastic as their famous companion product, NEFSLABS. These "traffic-tested" markers, strips, and arrows will wear and wear, as evidenced by case studies of NEFSLABS taken in numerous metropolitan areas. Proof is yours for the asking. These studies reveal that NEFSLABS color permanence and reflective visibility provide increased traffic safety.

NEFGLU is applied easily and quickly by using your existing paint equipment, or by brush. Used straight from the can, it requires no complicated equipment whatever.



NEFMATS are rolled out in one piece. Each letter is permanently flush-fit in its background mat. Never any marking, cutting, or piecing.



NEFMATS are permanently bonded to the road surface. By merely rolling over the mats, permanent adhesion of mat to road is accomplished. That's all . . . now traffic may go, go, go!



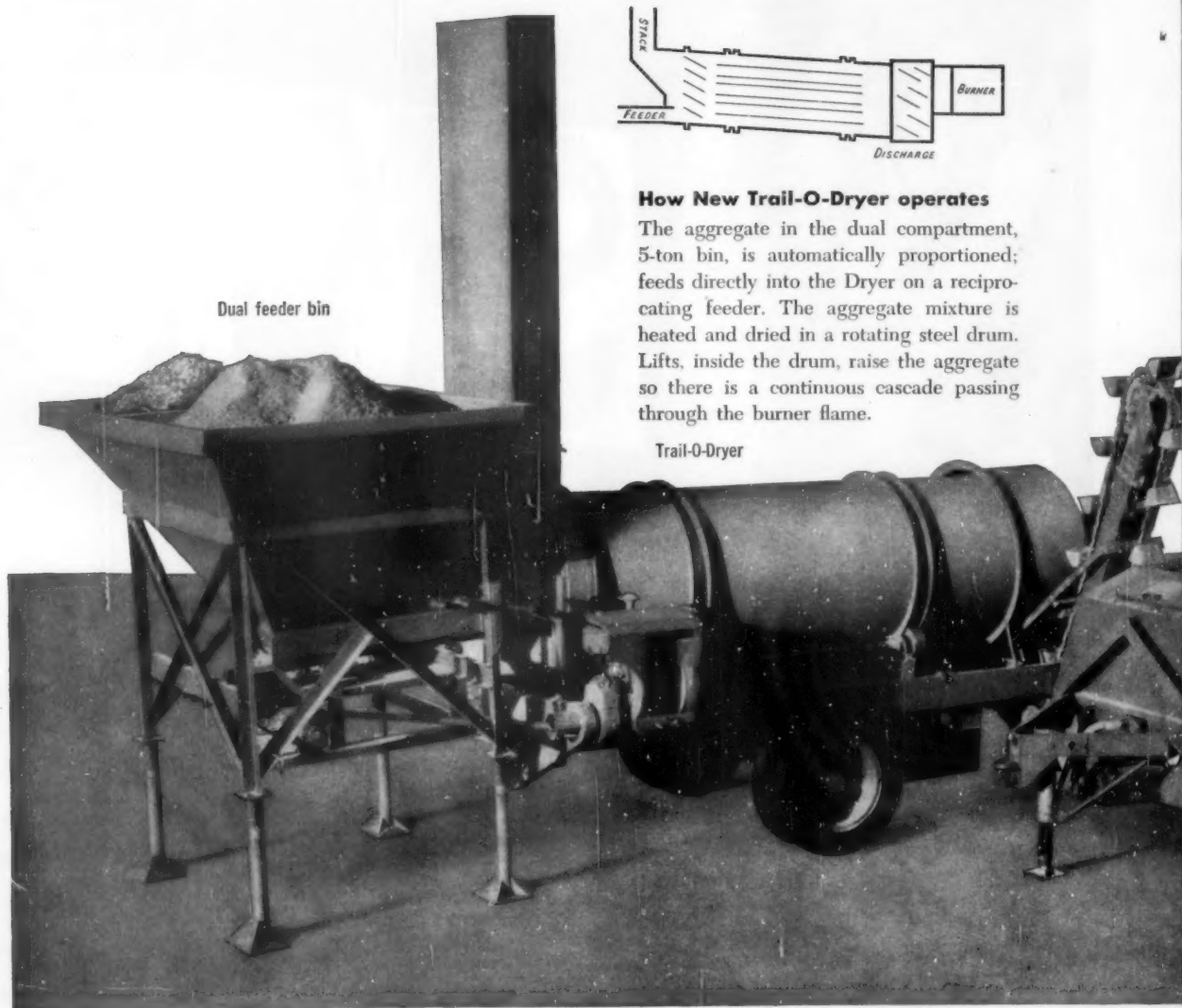
★ TRADEMARK APPLIED FOR

J. W. NEFF LABORATORIES, INC.

STOCKERTOWN 3, PA.

new Littleford model 25T Trail-O-Dryer . . . and the famous Littleford Trail-O-Patcher combine to produce a new, complete

SMALL PORTABLE



Dual feeder bin

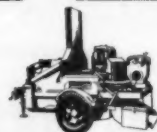
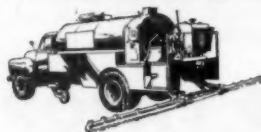
How New Trail-O-Dryer operates

The aggregate in the dual compartment, 5-ton bin, is automatically proportioned; feeds directly into the Dryer on a reciprocating feeder. The aggregate mixture is heated and dried in a rotating steel drum. Lifts, inside the drum, raise the aggregate so there is a continuous cascade passing through the burner flame.

Trail-O-Dryer

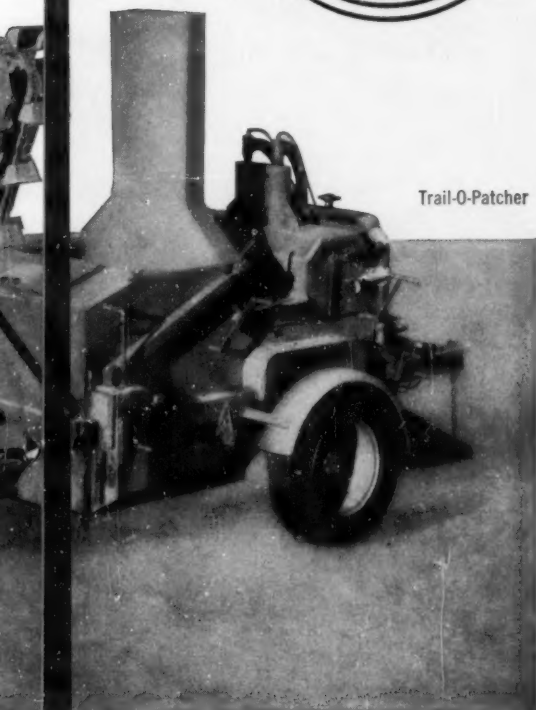
LITTLEFORD

the world's most complete line of completely engineered



KETTLES • EMULSION SPRAYERS • HEATER-PLANER-SURFACE HEATER • BITUMINOUS DISTRIBUTORS • BITUMINOUS MIXERS • ROAD BROOMS • ROLLERS • PAVES-SPREADERS

ASPHALT PLANT



Trail-O-Patcher

Now every contractor and highway department can afford an asphalt plant. Simply team up the brand new Littleford Trail-O-Dryer with the well known Trail-O-Patcher. The Trail-O-Dryer will produce 15 to 25 tons of hot, dry aggregate for quick mixing in the Trail-O-Patcher. And there you have a 15 to 25 tons per hour asphalt plant that can be taken right out on the job.

This efficient new Littleford combination sells for approximately half the price of the next largest size comparable plant. It's a size everyone can use—at a price everyone can afford.

The new Trail-O-Dryer is good news for the many owners of Littleford Trail-O-Patchers, since it will boost your patcher output 100%! May be used with other types of bituminous mixers, too.

Operation of the Littleford Dryer-Patcher combination is simple and practically automatic . . . including automatic proportioning of gravel and sand; heating, drying and delivering the mixed aggregate to the Patcher; mixing the dried, heated aggregate with bitumen in the pugmill; and discharging the finished black top material into waiting truck bed without additional handling. Automatic performance like this assures better paving material, prepared right on the job, at big savings.

For information on how this remarkable new Littleford combination can help mechanize, improve and reduce the cost of your black top road construction and maintenance, send today for free descriptive bulletin 36. Littleford Bros., Inc., dept. LB 245—452 E. Pearl St., Cincinnati 2, Ohio.

black top equipment



SUPPLY TANKS • TANK CAR HEATERS • UTILITY SPRAY TANKS

PUBLIC WORKS for January, 1957

Send for free Trail-O-Dryer bulletin



Littleford Bros., Inc.:

Please send my free copy of new Trail-O-Dryer and dual feeder bin bulletin 36 immediately and without obligation.

Name

Company

Street

City Zone State

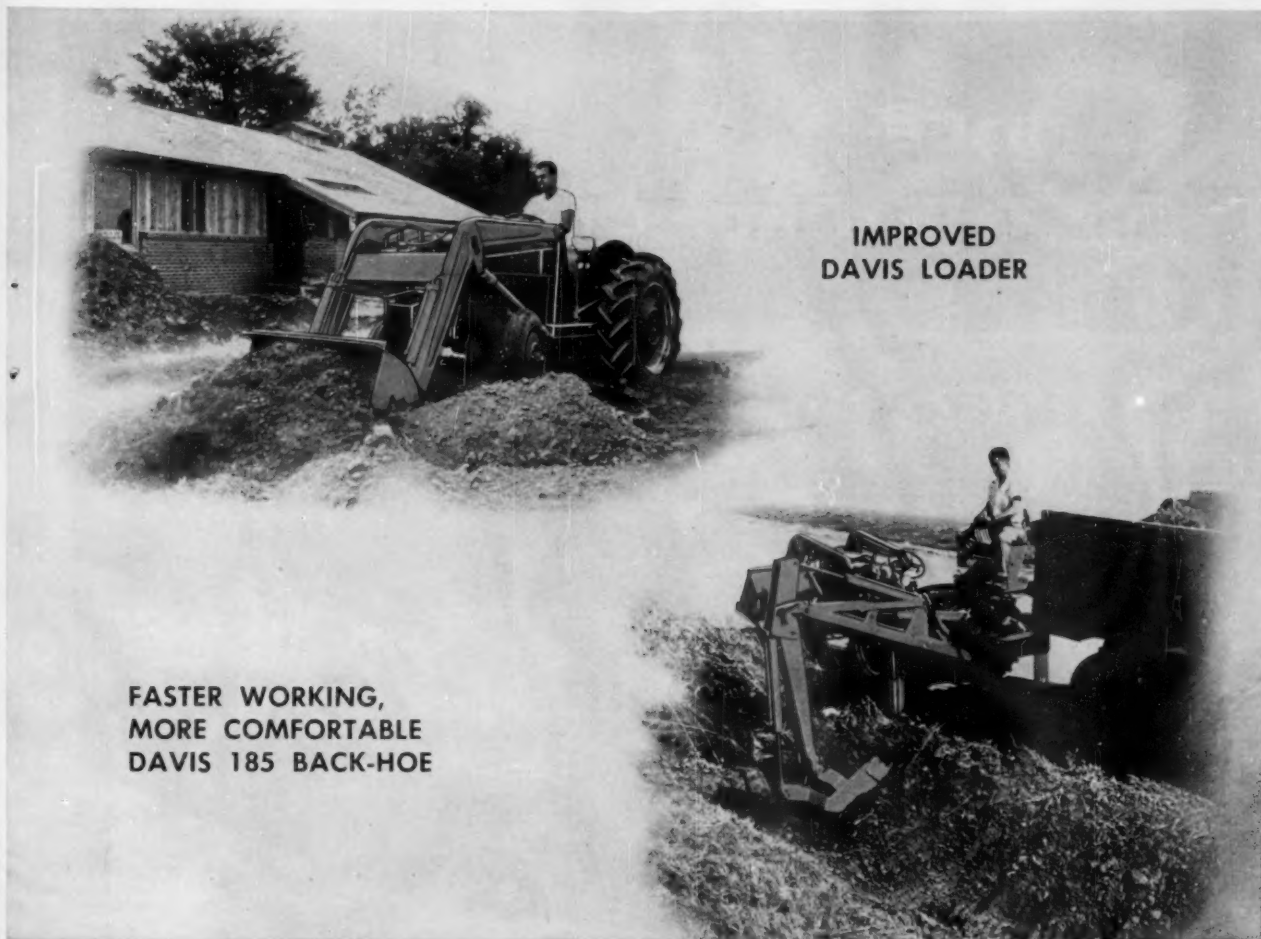
FLUSH DIGGING AND
200° OPERATING ARC ON
DAVIS 210 BACK-HOE



LOW-COST,
TRUCK-MOUNTED BACK-HOE



THE EQUIPMENT THAT LEADS THE WAY



IMPROVED
DAVIS LOADER

FASTER WORKING,
MORE COMFORTABLE
DAVIS 185 BACK-HOE

New Back-Hoes and Loaders for 1957 ...make More Profits for You!

Here's good news for back-hoe and loader users. Davis opens a whole new era of profits. **The New 210 Davis Back-hoe** has three interchangeable mounting points so you can switch digging positions from center to side for flush digging alongside buildings, fences, etc. . . and an engineering achievement desired by all — but accomplished only by Davis — an exclusive **hydraulic rotary boom swing cylinder** that gives smooth, continuous **200° cushioned operating arc** without ever changing a pin. Both the new 210 and the popular 185 have 7,000 pounds of breakaway power and an adjustable seat with extended foot rests.

Both models are now available as low-cost, **truck-mounted units** for any one-ton or larger flat-bed truck — self-powered, completely detachable, or attached in matter of minutes, and designed to fold into a compact package for easy transporting with everything being accomplished hydraulically. **The Davis Loader**, already the possessor of more "firsts" than any other make, has also been improved for even better workability. For better profits in 1957 . . . for better equipment in earth moving and material handling, see **DAVIS**, America's premium equipment that sells for competitive prices.

Available for Most Popular Tractors

Davis Products are sold and serviced anywhere in the United States.

Write for your dealer's name, please specify make of tractor and equipment desired.

MID-WESTERN INDUSTRIES, INC.

1009 S. WEST ST. DEPT. P, WICHITA, KANSAS



**HANDLE    3 LOADS
IN THE TIME OF   2**

and get big savings with

ROTO-PAC

On-the-job performance has proven that ROTO-PAC collects 3 refuse loads in the time it takes to collect 2 loads with the out-dated rear door compaction-type collection unit. The reason for this economy is ROTO-PAC's exclusive principle of escalator compaction.

Unlike conventional units, ROTO-PAC's *continuous* loading and compaction eliminates a separate loading cycle. The minutes saved at each stop mean up to one more full additional load per day per unit. Multiply this by your collection requirements and you'll see where the savings add up.

And, ROTO-PAC handles every kind of refuse with equal speed—ashes, rubbish, garbage, boxes, crates—all automatically broken up in the hopper and automati-



cally conveyed into the body. Even Christmas trees are pre-crushed to make more room in the body for greater compaction.

The savings your community can achieve in refuse collection with ROTO-PAC's faster operation are only part of the story. You'll want full details on ROTO-PAC's low operating costs too. Write today for a demonstration.



FACT-PACKED BOOKLET tells you what to look for in a collection unit. Don't buy any refuse collection unit until you have checked the Comparison Chart. Write or phone for your copy. Ask for No. 84.

CITY TANK CORP.

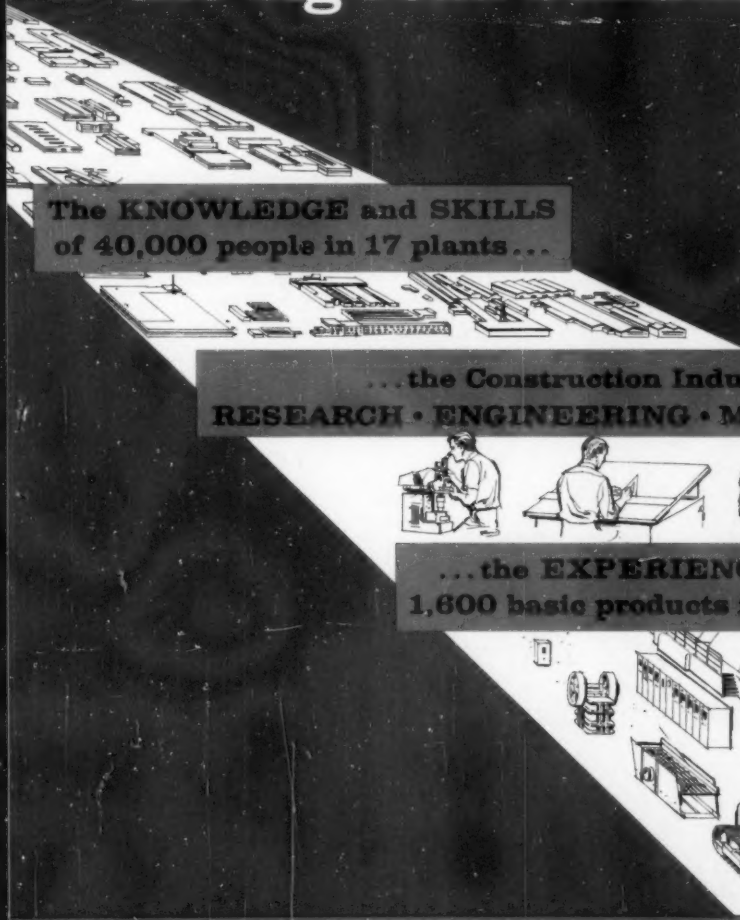
53-09 97th Place, Corona, N. Y.
Sales and Service in All Principal Cities

Road Show Highlights:

See how

ALLIS-CHALMERS Engineering-in-Action

can help you meet the challenge of
the big road-building years ahead!

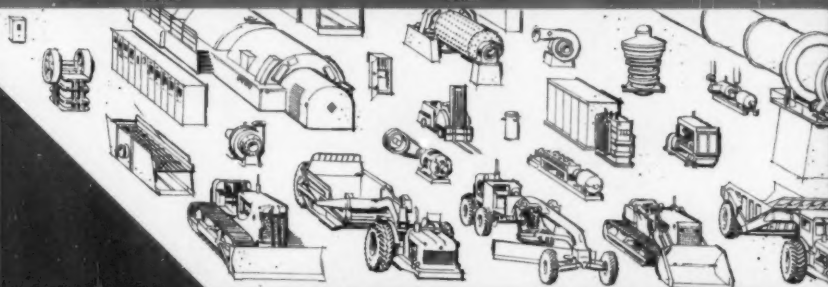


The **KNOWLEDGE** and **SKILLS**
of 40,000 people in 17 plants...

... the Construction Industry's broadest facilities in
RESEARCH • ENGINEERING • MANUFACTURING • DISTRIBUTION



... the **EXPERIENCE** gained in building more than
1,600 basic products for the world's major industries...



give **YOU** a complete line of advanced-design construction machinery...
for production and profit on the job!

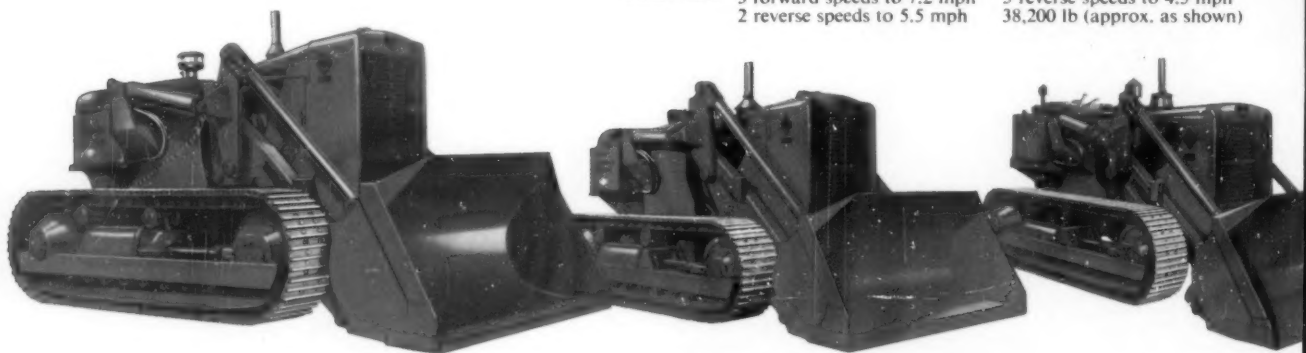
Engineering-in-Action FOR



HD-21 204 net engine hp
(torque converter drive)
2 forward speeds to 7.5 mph
1 reverse speed to 5.5 mph
53,400 lb (approx. as shown)

HD-16 150 net engine hp
(torque converter drive)
3 forward speeds to 7.2 mph
2 reverse speeds to 5.5 mph

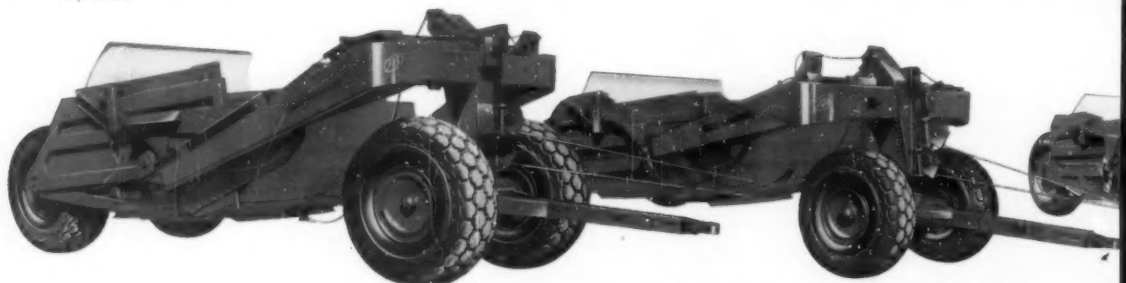
141 belt hp (standard transmission)
6 forward speeds to 5.8 mph
3 reverse speeds to 4.5 mph
38,200 lb (approx. as shown)



4-cu-yd HD-21G 204 net engine hp
(torque converter drive)
13-ft, 4-in. dump height
66,500 lb

3-cu-yd HD-16G 150 net engine hp
(torque converter drive)
12-ft, 3-in. dump height
47,800 lb

2 1/4-cu-yd HD-11G 111 net engine hp
11-ft, 7-in. dump height
32,000 lb



Model 315 Struck—15 yd
Heaped—20 yd
Cable control
25,850 lb

Model 108 Struck—8.4 yd
Heaped—11 yd
Cable control
15,250 lb



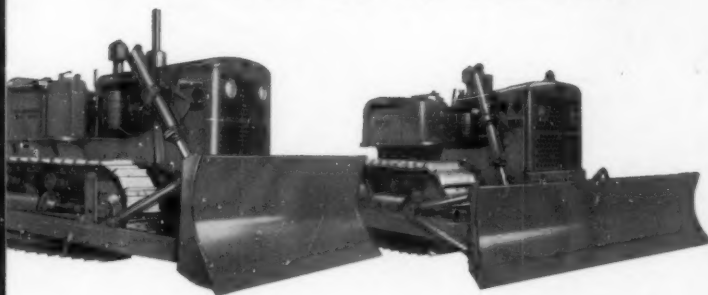
TS-360 280 hp
Struck—15 yd
Heaped—20 yd
Speeds—to 20.0 mph
Weight—49,050 lb
(approx.)

TW-360 Struck—17 yd
Heaped—22 yd
Tons—26
Weight—47,000 lb
(approx.)

TS-260 200 hp
Struck—11 yd
Heaped—14 yd
Speeds—to 20.0 mph
Weight—39,600 lb
(approx.)

PRODUCTION

AND PROFIT ON THE JOB

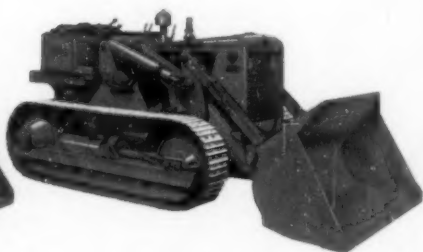


HD-11

94 belt hp
6 forward speeds to 5.7 mph
3 reverse speeds to 4.4 mph
24,600 lb (approx. as shown)

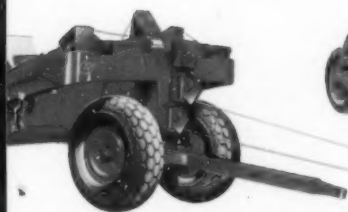
HD-6

63 belt hp
5 forward speeds to 5.5 mph
1 reverse speed to 2.0 mph
15,850 lb (approx. as shown)



**1½-cu-yd
HD-6G**

72 net engine hp
10-ft dump height
19,600 lb



Model 106

Struck—6.1 yd
Heaped—7.5 yd
Cable control
10,300 lb



Model 44

Struck—4 yd
Heaped—4.7 yd
Hydraulic control
6,595 lb



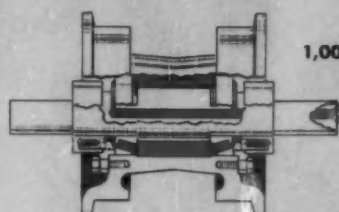
TR-260

Struck—11 yd
Heaped—15 yd
Tons—18
Weight—43,800 lb
(approx.)

Examples of Engineering in Action ADVANTAGES pioneered and proved by Allis-Chalmers

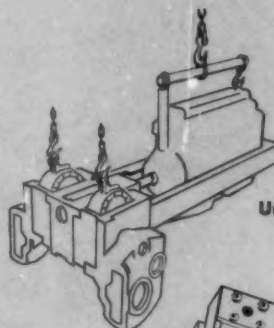
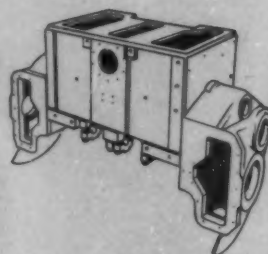


Torque converter drive

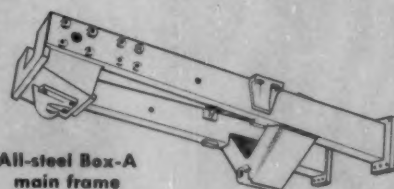


1,000-hour lubrication intervals

One-piece steering clutch and final drive housing

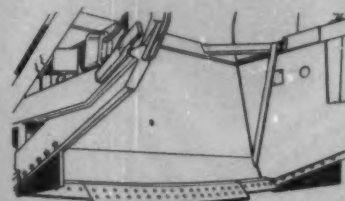
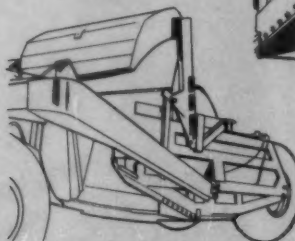


Unit construction



All-steel Box-A main frame

High apron lift and positive ejection



Curved bowl bottom and offset cutting edge

Engineering-in-Action

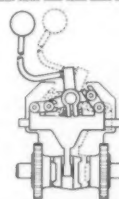
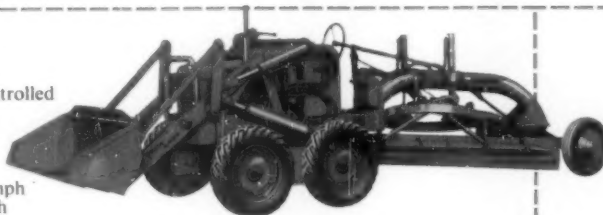
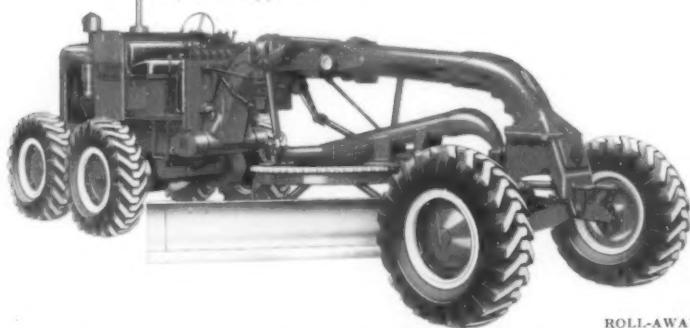
FOR PRODUCTION AND PROFIT ON THE JOB

**Model D
Standard
and Rear-End Loader**

8,800 lb (gasoline)
9,350 lb (diesel)
3/4-cu-yd bucket—
hydraulically controlled
Loader—2,200 lb
(approx.)

**FORTY
FIVE**

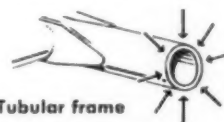
120 brake hp
6 forward speeds to 20.6 mph
3 reverse speeds to 7.0 mph
23,800 lb (approx.)



Toggle-type control



Roll-Away moldboard



Tubular frame

ROLL-AWAY is an Allis-Chalmers trademark.



POWER UNITS

Choice of sizes from 28 to 243
max. brake hp (at 1800 rpm)
Choice of fuel

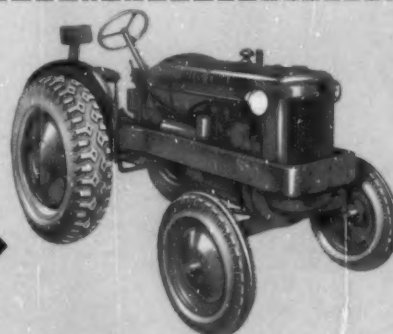
WHEEL TRACTORS

Model IB

22.87 belt hp

Model WD-45

45 belt hp



TRUE ORIGINAL PARTS AND SERVICE

Your Allis-Chalmers construction machinery dealer offers you the benefits of factory-trained, well-qualified men to provide fast, expert service on your equipment and keep it working at designed capacity. He stocks only *True Original Parts*, engineered right, manufactured right, to perform right . . . help you take full advantage of the big road-building years ahead.

ALLIS-CHALMERS, CONSTRUCTION MACHINERY DIVISION, MILWAUKEE 1, WISCONSIN

ALLIS-CHALMERS





**THEY KEEP THE SEA OUT OF
SANITARY SEWER LINES WITH**

TYLOX

Rubber

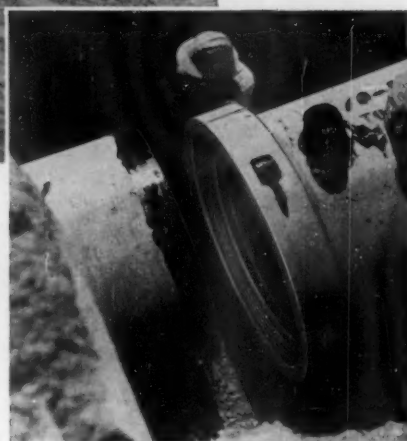
PIPE JOINTS

Corrosive sea water . . . shifting beach sands . . . sub-surface volcanic tremors! . . . These were conditions confronting designers of Honolulu's new Aina Haina-Wailupe sanitary disposal line recently constructed in the land of the lei. With such severely destructive conditions prevailing, the question "what pipe joint?" was a critical one. The coupling had to be *flexible*, *inexpensive* to install, and *water-tight*.

Engineers solved the problem with a TYLOX RUBBER JOINT specification. TYLOX, they knew, cuts construction costs by speeding pipe-laying, makes pipe joints permanently water-tight with a compression seal, and never deteriorates because of the special compounding of its rubber. In fact, TYLOX was the *only* pipe joint fully meeting their rigid requirements for economy, safety and long life of the line.

Write for more TYLOX data and case histories. Honolulu is only typical of how big and little cities the world over use TYLOX to assure fast-working, leak-proof and long-lasting pipe joints. Always write "TYLOX Rubber Joints" when preparing specifications. There are no "or equals."

3044



PROJECT: Sanitary sewer expansion to serve residential areas of Aina Haina and Wailupe, near Honolulu, Hawaii.

ENGINEERS: Chief Engineer, William C. Vannatta, Robert Cole and Harry Finley, all of the City and County Division of Sewers.

CONTRACTOR: Hawaiian Dredging Co., Honolulu, Hawaii.

PIPE: 30" and 40" dia. reinforced concrete pipe, specially designed and manufactured for the project by Concrete Products Division of Honolulu Construction & Draying Co., Ltd., Honolulu, Hawaii.

HAMILTON KENT MANUFACTURING COMPANY

KENT, OHIO

427 West Grant St.

ORchard 3-9555



Up it comes as the operator slides the cutting-edge under the concrete and applies break-out action. Photo shows how the slab usually breaks before it topples over.

Authorities forbid breaker ball, so contractor removes 8" concrete with 2¼-yd. Michigan

Contractor Roberts E. Latimer, Jr., Inc., Silver Spring, Maryland, ran into trouble on a recent job. The contract called for removing a stretch of highway where the concrete slabs were 8-inches thick by 12-ft. wide. When they bid the job they expected to break up the slabs with a breaker-ball. But when they went to work, authorities told them that a decayed 14-inch gas main ran underneath the road. "No breaker-ball—too dangerous."

Crane wouldn't work

Latimer tried to break out the slabs with a ¾-yd. crawler shovel; it wouldn't work. Next they tried a crawler-loader; it didn't have enough lifting capacity or break-out power either. At this point Paving Supply and Equipment Co., Washington, D. C., sug-

gested that they try a 2¼-yd. Michigan Model 175A on the job. Latimer frankly didn't believe that any type of loader could break out the heavy slabs—much less a rubber-tired machine. But they finally agreed to let the distributor demonstrate the Michigan. When they saw, they bought.

Michigan's exclusive break-out action

The photograph on this page shows how the 133-hp Michigan handles the job. The operator slips the bucket cutting-edge under the slab. Then he applies bucket break-out action. When the slab has lifted about 2 feet, he eases forward, gets under the slab as he lifts the bucket. The concrete usually breaks as it's being raised. If it doesn't break, the Michigan pushes it over the curb to a spot where the breaker-



On a similar job in Philadelphia, Union Paving Company uses a Michigan 125A (1½-yd. capacity) to break and load out 8-inch concrete slabs. This bucket-load weighs about 6000 lbs.—well below the 11,000 lb. rated capacity of the 96-hp Michigan. When the operator steps on the brake, the power-shift transmission automatically goes into neutral—puts all the engine power into the bucket hydraulic system. This feature is standard on all Michigans.

ball can be used safely. Then the Michigan loads out the chunks.

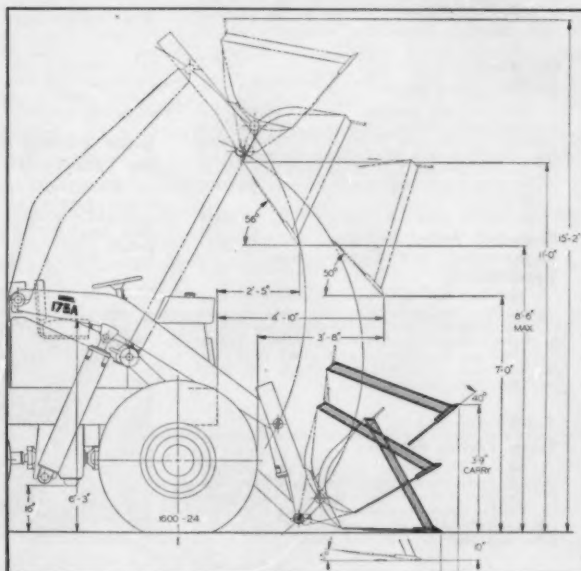
Moral: see it in action

Like Roberts E. Latimer, Jr., Inc., more and more contractors are using Michigan Tractor Shovels as construction prime-movers. It's no accident that this machine will handle jobs that have never even been attempted on rubber. The complete Michigan power-train—torque converter, power-shift transmission, planetary axles—was designed and built by Clark to give this machine more useable power and traction than you've ever seen on any rubber-tired tractor shovel. Before you decide that this type of machine can't handle a particular job, do what Latimer did. Ask for a Michigan demonstration. *You name the job.*

**CLARK®
EQUIPMENT**

Michigan is a registered trade mark of
**CLARK EQUIPMENT
COMPANY**
Construction Machinery Division
2499 Pipestone Road
Benton Harbor 13, Michigan

Below: Low-level breakout force of the Michigan 175A is applied by two 7-inch double-acting bucket cylinders; the full tip-back is 40 degrees. Note the clean design of the Michigan bucket mechanism—preserves the dumping clearance over truck sideboards.





EQUIPMENT DATA to Help Your

PUBLIC WORKS PROGRAM

NEW LISTINGS

Tractor-Shovels of Any Size and Bucket To Fit Your Need

21. Literature is available on 7 basic models of tractor-shovels that are gas or diesel powered, 44 to 165 hp., front, rear and all-wheel drive from Clark Equipment Co., Pipestone Rd., Benton Harbor 43, Mich. Check the reply card for information on 35 different buckets and attachments ranging from 6 cu. ft. to 5 cu. yds.

Information on The Ottawa Heavy-Duty Backhoe

25. Features of this backhoe are an automatic ejector bucket; two levers do four operations; and a powerful hydraulic system with mechanical linkage to provide more digging power. For complete details check the reply card or write Ottawa Steel Div., L. A. Young Spring & Wire Corp., Ottawa, Kans.

Valuable Catalog on Power Gates, Loaders and Hydraulic Hoists

40. A comprehensive catalog on garbage dump bodies, truck dump bodies, hydraulic hoists, power loaders and power gates has been released by Daybrook Hydraulic Div., Bowling Green, O. Engineering data, specifications and models are covered. Check the reply card.

Foundation Services For the Nation's Highways

56. Raymond Concrete Pile has just released a very good catalog illustrating its facilities for constructing foundations for highway structures. Also shown are many bridges and crossovers on highways across the nation. Check the reply card or write Raymond Concrete Pile Co., 140 Cedar St., New York 6, N. Y.

Save Space By Filming Your Records

57. Microfilm your records by using the Recordak Microfilmer. Check the reply card or write Recordak Corp., 415 Madison Ave., New York 17, N. Y., for operation, use and price of this machine. Also available is literature on the Recordak Verifax Copier that makes certified copies 15 times faster than typing.

One-Piece Traffic Letter Mats

43. Brightly colored, flexible plastic, reflective traffic letter mats are described in literature released by J. W. Neff Laboratories, Inc., Stockertown 1, Pa. Check the reply card for information on how these mats are placed on the streets and highways and where they can be used.

Frameless Metal Buildings For Maintenance and Construction Departments

83. Flat top, clear span, column type, multiple gable roof and high pitch roof are the types of design covered in literature just issued by Behlen Mfg. Co., Columbus, Nebr. Behlen buildings are available in galvanized steel, aluminum steel or aluminum. Check the reply card for your information.

Trafficones For Every Traffic Problem

99. Trafficones and adapters are described fully in literature available from Interstate Rubber Products Corp., 908 Avila St., Los Angeles 12, Calif. These Trafficones are made of flexible natural rubber paint guaranteed not to discolor and built to withstand abuse.

The engineering information in these helpful catalogs will aid you in your Engineering and Public Works programs. Just circle numbers you want on the reply card, sign and mail. This free Readers' Service is restricted to those actively engaged in the public works field.

Literature on the Four- Wheel Drive Jeep Truck

144. The FC-150, "Forward Control" Jeep truck is described fully in literature available from Willys Motors, Inc., Toledo 1, Ohio. A few engineering features are 81-inch wheelbase, 18-ft. turning radius, 9 forward and 3 reverse power combinations and four-wheel drive. For complete specifications check the reply card.

Swimming Pool Equipment Catalog With Data and Selection Guides

156. Pool equipment designed for municipal, club and commercial swimming pools of moderate to large size is covered in Catalog 803 issued by the Swimming Pool Division, Elgin Softener Corp., Elgin, Ill. Sections covered are fittings, water purification equipment, deck equipment and engineering data. Check the reply card today.

Manual on Sewer Structures



178. This is a 48-page manual on installation design, reference data and graphs showing discharge of pipe based on Manning's formulas. Also such subjects as structural durability, material durability; selection of structures; factors influencing capacity; joints and fittings; and linings for failing sewers are covered. Copies of Manual CMS-7456 are

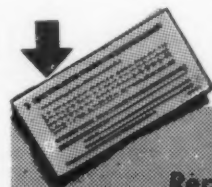
available from the Product Information Service, Armco Drainage & Metal Products, Inc., Middletown, Ohio, or by checking the reply card.

Three-Horizontal Red-Traffic-Signal

244. A new three horizontal red traffic signal is described fully in literature available from Southern Signals Inc., 222 Beach St., Shreveport, La. Maximum controlled intensity, greater range of readability and maximum coverage are features. Check the reply card today.

Eaton 2-Speed Axles For Your Trucks

264. Truck axles that provide easy shift, supply positive lubrication and have a self-contained air brake are available from Eaton Mfg. Co. For complete information on these rugged axles check the reply card or write Eaton Mfg. Co., Cleveland, Ohio.



Use the
Reply Cards
Inside Front Cover

How Mercury Vapor Outdoor Lighting Brings More Night Action

114. This bulletin illustrates the use of mercury vapor lamps for shopping centers, parking lots, transportation terminals and industrial areas. For information on Sylvania's silver white lamp and golden mercury vapor lamp write Sylvania Electric Products Inc., 60 Boston St., Salem, Mass., or check the reply card.

Information on Service, Valve, Roadway and Meter Boxes

122. Literature on specifications covering "Buffalo" service, valve, roadway and meter boxes, and adjustable valve boxes for water and gas has just been released from Buffalo Pipe & Foundry Corp., Box 55-Station B, Buffalo 7, N. Y. Check the reply card for your information on these valve boxes.

Sidecrane-Backfiller-Tamper, A Versatile 3-Way Machine

125. A 3-way machine, the Cleveland 80W, that is a backfiller, sidecrane and tamper is described fully in a 12-page Bulletin, No. L-102, available from The Cleveland Trencher Co., 20100 St. Clair Ave., Cleveland 17, Ohio. Design and construction features, photographs of the machine in operation and complete dimensions and specifications are covered. Check the reply card.

Bulletin on Chlorine Gas Feeders

134. Simplicity of operation and the four types of control are diagrammed of the Builders-Providence Models CVS and DVS chlorinizers in Bulletin 840-N10 just issued by Builders-Providence, Inc., 345 Harris Ave., Providence, R.I. Construction features, operation and application advantages, safety features, dimensions and control variations are discussed. Check the reply card for your copy.

Engineering Data Manual on Underground Lift Stations

218. This manual includes descriptive bulletins, specifications covering typical installations for pump type or ejector type stations, friction loss tables covering capacities and size of pipe, pump and motor selection charts and wiring diagrams. Check the reply card or write Smith & Loveless, Inc., Water and Sewage Equipment, P. O. Box 8172, Kansas City, Mo., for your copy.

Power Crane-Shovels in 4/10 and 5/10 Cu. Yd. Sizes

219. Information on three new power crane-shovel models has been issued by the "Quick-Way" Truck Shovel Co., Denver, Colo. The Model 85A is a truck mounted 4/10 cu. yd. crane shovel, the Model 105AC is a crawler in a 5/10 cu. yd. capacity, and the Model 85AC is a 4/10 cu. yd. crawler mounted shovel. For your literature check the reply card today.

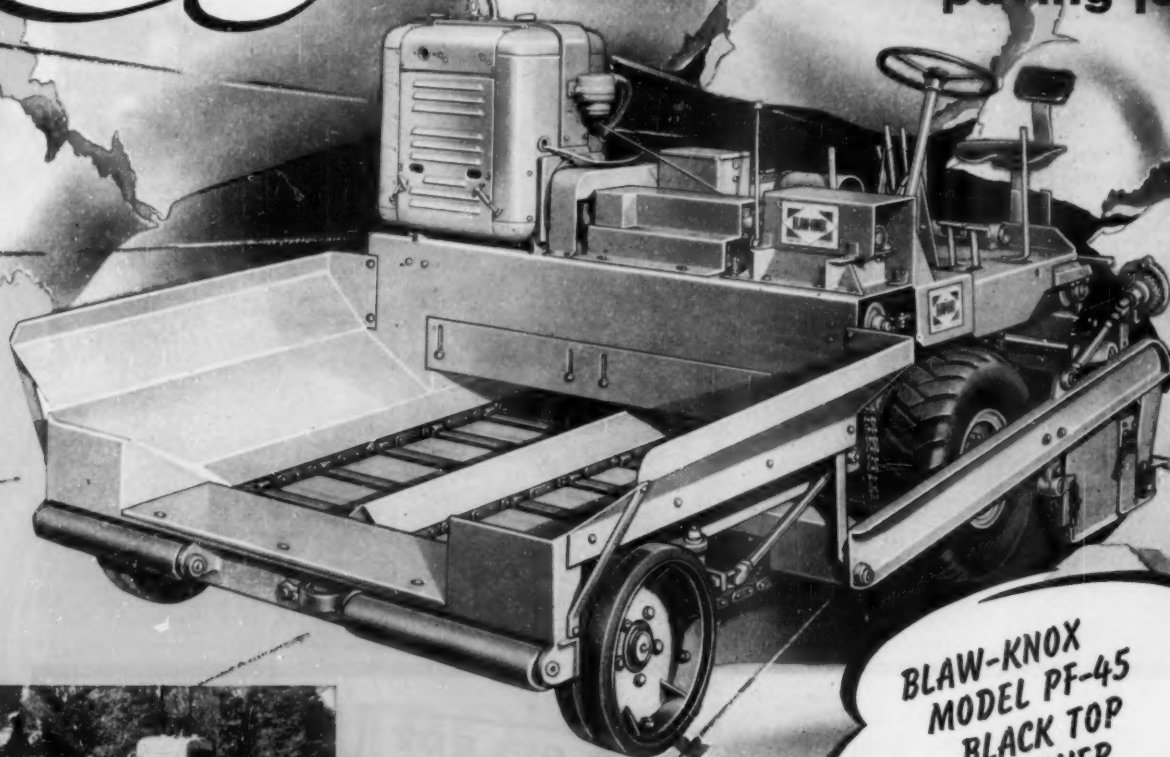
Heavy Duty Air Cooled Engines For Many Uses

223. Power and weight specifications, dimensions and uses are fully covered in literature issued by Wisconsin Motors Corp., Milwaukee 46, Wis., on their air-cooled engines. Also available is a service map and a list of their distributors and approved service stations. Check the reply card.

NEW

HERE'S A NEW MACHINE FOR BIG PROFITS

on small black top paving jobs



**BLAW-KNOX
MODEL PF-45
BLACK TOP
PAVER**

Now, for little more than half the cost of a big paver, you get the new, small, light weight Blaw-Knox PF-45 Black Top Paver that will give you big profits on small paving jobs. Similar in design and construction to the big Blaw-Knox Model PF-90 Paver-Finisher, the Model PF-45 Black Top Paver is the first machine of its kind that is designed specifically for small to medium sized bituminous paving jobs. It has a combination of speed, power, maneuverability, versatility and low operating cost that has never before been put into a black top paver requiring so low an investment.

You can see this new Black Top Paver at the Road Show, Jan. 28 to Feb. 2, at the Blaw-Knox Booth, No. 727 located on the corner of the Ohio Turnpike and 10th Avenue East in the Exposition Hall of the International Amphitheatre. Your Blaw-Knox distributor also can give you complete information.



BLAW-KNOX

BLAW-KNOX COMPANY

Construction Equipment Division

43 Charleston Ave., Mattoon, Illinois

To order these helpful booklets check the reply card inside front cover.

Vertical Pressure Filters For Clarifying Water

100. Complete details on the Cochrane vertical pressure filters for use in many types of institutional and commercial applications are covered in bulletins just released by Cochrane Corp., 17th St. below Allegheny Ave., Philadelphia 32, Pa. Check the reply card for information on filter bed materials, design features, available accessories as well as drawings.

Equipment For the Measurement and Control of Liquids and Gases

105. Meters, orifice flow, laminar, gauges, controllers, valves and pitot equipment are equipment covered in this 38-page catalog. Check the reply card or write Simplex Valve and Meter Co., Lancaster, Pa. for description, operations, specifications, applications and advantages of these equipment.

Mercury Vapor Street Lighting

193. This bulletin entitled "Mercury Street Lighting" covers the use of mercury vapor luminaries in lighting streets and highways—residential and business, whiteways and turnpikes. Technical data on photometric performance, distribution of initial candlepower and dimension diagrams of the various units are included. Check the reply card or write News Bureau, General Electric, Schenectady 5, N. Y. for Bulletin GEC-1403.

Manual on All Types of Traffic Signs

200. This 26-page manual covers regulatory, warning, school, railroad, street name, road construction, route markers, miscellaneous signs and plastic reflectors. Check the reply card or write The Miro-Flex Co., Inc., 1824 East Second St., Wichita 7, Kas. for complete information on signs.

Chapman Standard Sluice Gates

276. Manual, hydraulic or electric motor control sluice gates are described fully in Catalog 25 available from The Chapman Valve Mfg. Co., Indian Orchard, Mass. These valves are easy to replace and are fitted without alterations. Check the reply card.

Better Field Testing for Highway Foundations

279. A new soil testing device for making field density and moisture tests is suitable for use in all soils, including fine, coarse, granular base and gravel. Called the Washington Densometer, it features unexcelled accuracy, completes tests in 3 minutes, is light weight, compact and economical to operate. Get further details from Charles R. Watts & Co., 4121 Sixth Ave. NW, Seattle 7, Wash.

Review of Diatomite Filtration of Water

285. A detailed review of the application of diatomite in the general field of water filtration, including uses in municipal supply and swimming pools is contained in a well-prepared 16-page bulletin. Specific applications to certain water treatment problems are also discussed. Write to the Diatomite Division, 612 So. Flower St., Los Angeles 17, Calif. for Bulletin F-552 entitled, "Diatomite Filtration of Potable Water," or check the reply card.

Information on Aluminum Lighting Equipment

296. Aluminum standards, brackets and lighting equipment are described fully in a catalog available from Hubbard Aluminum Products Co., Division of Hubbard and Co., Pittsburgh 1, Pa. Check the reply card today for information on poles designed for every outdoor lighting application.

Center Mounted Grader Blades For Utility Tractors

302. Grader blades that can be center mounted on most makes of utility tractors are described in literature available from J. R. Prewitt & Sons, Pleasant Hill, Mo. Units are ideal for road maintenance, shoulder work, landscaping and snow removal. Check the reply card.

Four-Way Grid Open Steel Bridge Flooring

313. Grids are made in lengths up to 36 ft. and 7-ft. 3-in. widths. The 4-way grid provides a flat, single plane, serrated surface—gives a straight, smooth ride and reduces tire hum to a minimum. For full information on

this skid-resistant flooring check the reply card or write Greulich Bridge Flooring Div., Kerrigan Iron Works, Inc., Nashville, Tenn.

Heavy Duty Raw Sewage and Sludge Pumps

317. The SP-5 raw sewage and sludge pump is designed to operate at heavy duty, high head application and is particularly adapted for pumping sewage or sludge over long distances. Bulletin 198, describing the SP-5, may be obtained from the Chicago Pump Co., 422 Diversey Parkway, Chicago 14, Ill. Check the reply card.

WATER WORKS

Ball and Socket River Crossing Cast Iron Pipe

33. Literature is available describing Clow ball and socket cast iron pipe for river crossing, or any installation where full 15 degree free turning deflection is desirable. For full description and specifications, address James B. Clow & Sons, Inc., P. O. Box 6600-A, Chicago 80, Ill., or check the reply card.

100 Page Book Helps Solve Water Problems

71. pH and Chlorine Control. A discussion of pH control and description of comparators, colorimeters and similar devices. A 100-page booklet is available by checking reply card W. T. Taylor Co., 7304 York Road, Baltimore 4, Md.

Convenient Reference Manual Covers Cast Iron Pipe, Valves and Hydrants

76. An 80-page manual, issued by R. D. Wood Co. Independence Sq., Philadelphia 5, Pa., presents specifications for "Sand-Spun" cast iron pipe and fittings, outlines types of joints available, lists dimensions and weights in convenient tables and includes, in addition, full engineering data on the Mathews fire hydrant and R. D. Wood gate valves.

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Designed and manufactured by a century-old concern with 40 years' experience in designing, engineering and completely manufacturing hydraulically-powered stokers.

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① *For skidproofing with abrasives.* Calcium Chloride treated abrasives anchor to roads, hills, on contact. Can't blow off — instantly effective. Solvay Calcium Chloride doubles skidproofing efficiency of abrasives, prevents freezing of stockpiles.

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Effective at lower temperatures — leaves no white residue.

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To order these helpful booklets check the reply card inside front cover.

Waterstops For Expansion and Construction Joints

19. A polyvinylchloride waterstop "Dura-joint", that is resistant to extreme waterhead pressures, tensile strength of not less than 1900 psi, chemically inert and available in easy to handle 50 ft. coils is described fully in literature from W. R. Meadows, Inc., 24 Kimball St., Elgin, Ill., or Tecon Products Inc., 304 S. Alaskan Way, Seattle 4, Washington. Check the reply card for full information.

Engineering Information and Water Distribution Products

49. Helpful engineering information, covering water distribution problems, is available from Mueller Company in their W-96 Water Works Catalog. The 328 page catalog features a quick reference sectional indexing arrangement for easy location and identification of the hundreds of water distribution and service products illustrated. Check the reply card and you will receive detailed information on a complete line of water works equipment.

Use The Reply Card

Meter Features That Help Make Water Works Profitable

59. Simple design, accuracy and long life, moderate first cost and inexpensive maintenance are features of American water meters described in Bulletin No. 56 of the Buffalo Meter Co., 2917 Main St., Buffalo 14, N. Y. Be sure you have this informative booklet which gives the details of American meter design and construction plus full data on sizes, capacities and dimensions. Check the reply card.

Quick Review of Water Meters

316. A helpful condensed catalog which covers sizes and types of water meters for every kind of service is available from Rockwell Mfg. Co., 400 N. Lexington Ave., Pittsburgh 8, Pa. Each type is illustrated and fully described; specifications and prices are included. Gen. Bulletin W-800 by checking the reply card.

Manual on Pipe Finding Techniques

213. A manual on special pipe finding and leak detecting techniques of interest to utilities, municipalities, oil and gas companies is announced by Fisher Research Laboratory, Inc., 1961 University Ave., Palo Alto, Calif. The manual contains a number of articles on locating buried pipes and cables and detecting and locating fluid leaks in pipe lines. Check the reply card for your free copy.

Engineering Data on Asbestos Cement Pipe

372. Advantages of corrosion-free asbestos-cement pipe for water distribution plus full data on installation methods, cutting, making connections, testing, dimensions and weights are contained in the booklet, "Mains Without Maintenance," issued by Keasbey & Mattison Co., Ambler, Pa. Get your copies by checking the reply card.

What You Should Know About

Meter Setting and Testing Equipment

413. Complete details on all equipment and proper methods for meter testing and installation are included in an excellent book published by Ford Meter Box Co., Wabash, Ind. All water works men concerned with setting and testing meters will want a copy of this catalog, No. 56. Check the reply card for your copy.

Helpful Data on Swimming Pools

422. Complete data on McWane Super-DeLavaud centrifugally cast pipe with bell and spigot or mechanical joints is contained in Bulletin WP-54, issued by McWane Cast Iron Pipe Co., Birmingham 2, Ala. Size range includes 2" through 12" diameters, 18 feet long.

Compact Chemical Solution Feeder

576. The "Neusol" chemical solution feeder available in three standard sizes, 2.5, 5 and 10 gph, and incorporating either one or two positive displacement pumps is the subject of Bulletin 340-A. Write Inflico Inc., Tucson, Ariz., or check the reply card.

Helpful Data on Swimming Pools

364. Data on injector nozzles for complete recirculation, fittings for correct drainage and other useful information for pool design are covered in Manual SP issued by Josara Mfg. Co., Michigan City, Ind.

Complete Catalog and Reference Data on Valves and Fittings

211. The entire M & H line of valves, fittings and accessories for water works, filtration, sewage disposal and fire protection are illustrated and fully detailed in Catalog 52 issued by M & H Valve & Fittings Co., Anniston, Ala. In addition to complete data on these products, there are many pages devoted to helpful engineering data. Every designer should have a copy.

Water Lines Under Pavements Easily Installed

247. With a Trojan pipe pusher and puller no resetting of grip is required, so the work goes twice as fast. Two models, for pipe up to 2" dia. The larger model is available with air power unit to eliminate manual pushing. Get full details by checking the reply card. Trojan Mfg. Co., 1114 Race Dr., Troy, Ohio.

Auxiliary Electric Power For Public Utilities

249. Full descriptive information on Onan electric plants for every public utility need will be found in literature issued by D. W. Onan & Sons, Inc., Minneapolis 14, Minn. Be sure you have latest data on standby plants and controls for emergency electric power. Check the reply card now.

Points to Consider in Filter Sand Selection

332. Best operation of rapid sand filters requires filter media which is hard, properly shaped, carefully graded and perfectly clean. Filter sand and gravel which meets these exacting requirements is available on short notice from Northern Gravel Company, Box 307, Muscatine, Iowa. Get full details by checking the reply card.



Does bituminous paving or patch-work

Kwik-Mix bituminous mixers combine rubber-tired portability with big production capacity for paving roads, walks, parking areas, tennis courts, play grounds — and repairing busy streets, rail crossings. On patch-work, convenient end discharge permits direct pouring into pavement-break. On continuous paving operation, mixer can be towed by truck

(from which materials are supplied) and discharge the mix in windrows for spreading and rolling. 10 cu. ft. mixer can produce up to 22 tons per hour (based on 1½-min. mixing cycle, and aggregates weighing 110 lbs. per cu. ft.). On same basis, 14 cu. ft. mixer averages 30 tons hourly. See Kwik-Mix distributor or send for bituminous mixer catalog.

mail to

KWIK-MIX COMPANY, Port Washington, Wis. (Kochring Subsidiary)
Send us literature on: ☐ 10 ☐ 14 cu. ft. bituminous mixers.

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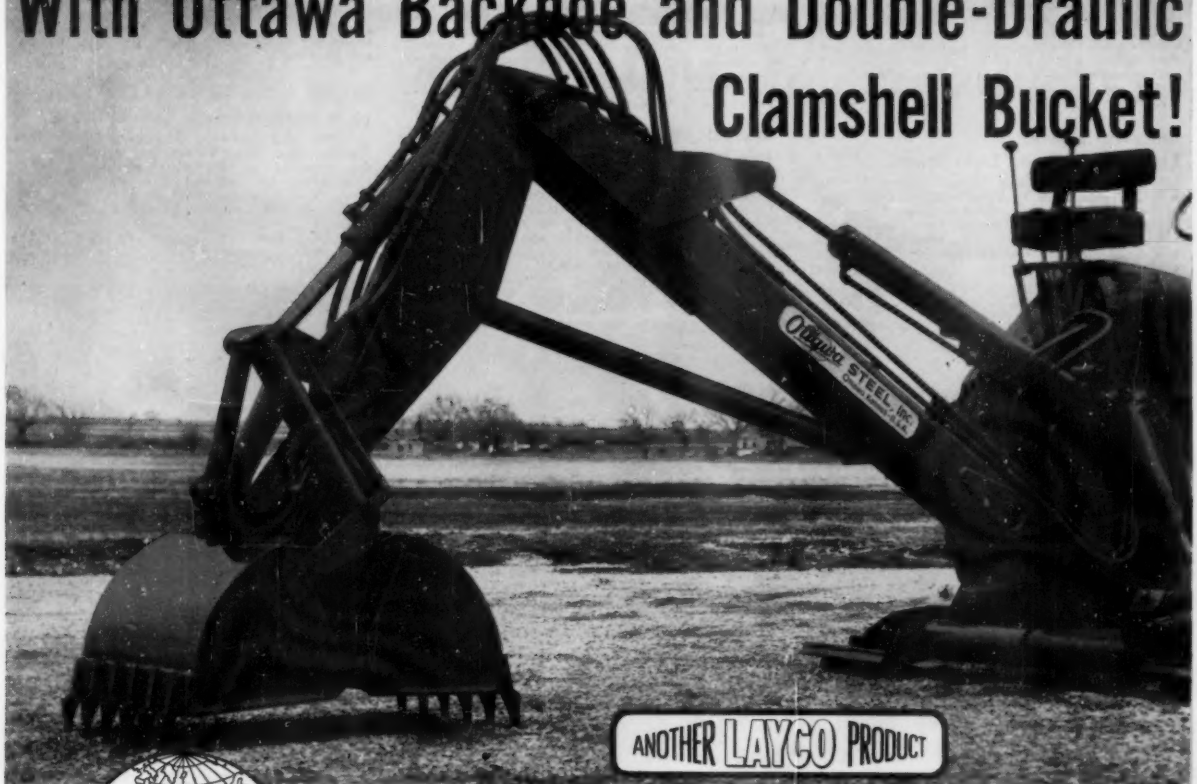
400 outside rooms with bath. Large-screen television and radio at no extra charge in every room. Air conditioning. Finest dining room. **ATLANTIC 1-6970**
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Contractor Saves More Than \$200 Per Day With Ottawa Backhoe and Double-Draulic Clamshell Bucket!



ANOTHER LAYCO PRODUCT



**OTTAWA
STEEL
DIVISION**

L. A. YOUNG SPRING AND
WIRE CORPORATION
OTTAWA, KANSAS

Removes 9000 Sq. Yds. of Concrete Rubble On Highway Patching Job in Illinois

Joyce Brothers Contracting Co. of Springfield, Ill. saved over \$200.00 a day when they used the Ottawa Big Muscle Backhoe and Double-Draulic Clamshell Bucket on an 82-mile highway patching job in Illinois. The fast, powerful action of the Ottawa Double-Draulic Clamshell quickly and easily removed 9000 sq. yds. of concrete rubble. Mr. Thomas Joyce, Jr., president of Joyce Brothers Contracting Co., says that the Ottawa Backhoe with Clamshell Bucket was responsible for the early completion of the job.

The Ottawa Backhoe and Double-Draulic Clamshell was a real money-saver! It reduced the labor force by 8 to 12 men, at an average of \$2.30 per hour, and did the work normally expected of a \$29,000 machine! Because Ottawa's exclusive One-Trol hydraulic system uses only two levers for all digging operations, it was so simple to operate, Mr. Joyce says, that the operator "could write his name with it!"

For more information on how the Ottawa Big Muscle Backhoe with Double-Draulic Clamshell Bucket can save you money, write to Ottawa Steel Division, L. A. Young Spring & Wire Corp., Ottawa, Kansas.

(LEFT) Clamshell bucket opens to 44". Powerful twin double-acting cylinders team up with down pressure for easy handling of toughest materials.

(CENTER) Cylinders can be operated individually or simultaneously. Either side of clam can be opened to use the other side as regular backhoe bucket.

(RIGHT) Closed Clamshell retains material, dumps directly into trucks. The Automatic Dirt Ejector dumps all wet, sticky material from bucket automatically.



To order these helpful booklets check the reply card inside front cover.

A Short Course In Pipe Jointing

169. The story of rubber couplings for clay and concrete pipelines is graphically presented in the booklet "Pipe Enterprise", published by Hamilton Kent Mfg. Co., Kent, Ohio. Detailed description of pipe jointing methods; photos showing jobs where Tylox gaskets met the need for easily assembled permanently tight joints installed under all conditions; and a report on the development, manufacture and outstanding features of the compression type gasket make this booklet valuable to every engineer and contractor. Check the reply card for free copy.

Complete Line of Electric Power and Light Plants

510. Gasoline and diesel engine driven electric power and light plants are fully covered in literature available from Universal Motor Co., Oshkosh, Wisc. Engines, generators, electrical equipment, weights and dimensions are some of the sections included. Check the reply card.

Bulletin Helps Specify A.W.W.A., Gate Valves

547. Double disc gate valves in 2" to 60" sizes are fully described in a 16-page bulletin which gives details on valve parts, design, materials, application of the "O" Ring Seal, operation and operating devices, directions for ordering valves and parts, dimensions of all sizes, and descriptions of eleven different methods for end connections. Valves for horizontal operation, square bottom valves, many types of gearing and gear cases, and a complete listing of special controls available are included. Get Bulletin A from Rensselaer Valve Co., Troy, N. Y. by checking the reply card.

Manhole, Water or Gas Valve Box Locator

603. A valve box locator or manhole finder is available from Aqua Survey & Instrument Co., 2012 Leslie Ave., Cincinnati 12, Ohio. Rugged and compact with no wires, batteries or switches, the Aqua box locator should be in every service car. For more information and price, check the reply card.

Discussion of Ranney Method For Municipal Water Production

116. A very interesting study of municipal and industrial water supply problems and a complete discussion of Ranney Collectors for water production will be found in a 20-page booklet published by Ranney Method Water Supplies, Inc., Box 5415, Shepard Station, Columbus 19, Ohio. Water quality, construction methods, costs, performance and other topics are considered. Check the reply card to get your copy.

Helpful Reference Catalog on Waterworks Gate Valves

146. All necessary details on Double Disc Parallel Seat Gate Valves for waterworks use are provided in the attractive 36-page bulletin issued by Ludlow Valve Mfg. Co., Inc., Troy, N. Y. Conveniently arranged design data shows all dimensions for 2" to 60" valves. Gearing, floor stands, operating devices are covered too. Get Bulletin 54W by checking the reply card.

What You Should Know About Steel Reservoirs and Standpipes

163. In a handsome 24-page booklet "Horton Steel Reservoirs and Standpipes," the Chicago Bridge & Iron Co., Chicago 4, Ill., shows installations from 50,000-gal. to 10,000,000-gal. capacity with several types of roof and special architectural features. Engineering data includes information on capacities, foundations and improved surface protection. Check the reply card to get your copy.

Factors to Consider in Elevated Tank Selection

299. Details on the several different types of elevated steel tanks, including capacity ranges, tank dimensions and other factors to be considered in the selection of elevated tanks for modern water storage, plus discussions of new tanks for old towers and foundations are included in Bulletin 101 of the Pittsburgh-Des Moines Steel Co., Neville Island, Pittsburgh, Pa. Check reply card for your copy.

Engineering Data on Equipment for Municipal Water Conditioning

347. For information on the design and operation of many types of water treatment plant equipment, including the Graver Reactivator, pressure filters, iron removal installations, zeolite softening and water conditioning for swimming pools get Bulletin WC-113 from Graver Water Conditioning Co., 216 West 14th St., New York 11, N. Y. Check the reply card.

Diesel Engines For Municipal Power Needs

359. Dependable power for water supply or flood control pumping stations, stationary or portable electric plants and many other municipal needs can be provided by engines described in literature of the Enterprise Engine & Machinery Co., 18th & Florida Sts., San Francisco 10, Calif. Get latest data by checking the reply card.

Important Factors in Water Meter Selection

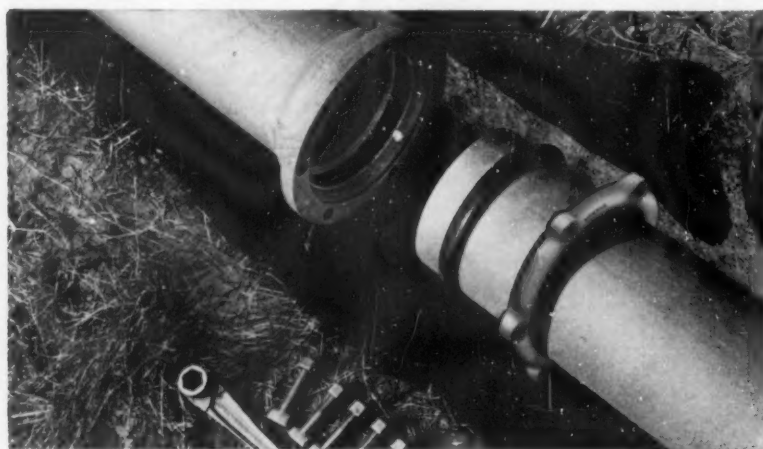
463. Interchangeability of parts is an important advantage that is yours when you use Trident meters. The newest parts fit your oldest Tridents so you modernize when you repair. Get full data on the entire Trident water meter line by checking the reply card or write to Neptune Meter Co., 19 West 50th St., New York 20, N. Y.

Bulletin On Locating Trouble in Pumps

533. A bulletin to help locate and correct common ailments of rotary, centrifugal and steam pumps has been released by Worthington Corp., Merchandising Sales Dept., Harrison, N. J. Pictures give a full description of pump troubles—from failure to deliver water to the loss of capacity after starting. For copies check the reply card.

Diatomite Filters in Water Filtration

596. A new line of IWF diatomite filters is featured in this 10-page Bulletin 651 by the R. P. Adams Co., Inc., 328 East Park Drive, Buffalo 17, N. Y. The IWF is ideal for medium and small town water supplies and the bulletin provides installation drawings, sectional views and operational sketches. Check the reply card for your copy of this helpful bulletin.



USE McWANE MECHANICAL JOINT
CAST IRON PIPE 2", 2 1/4" THROUGH 12"

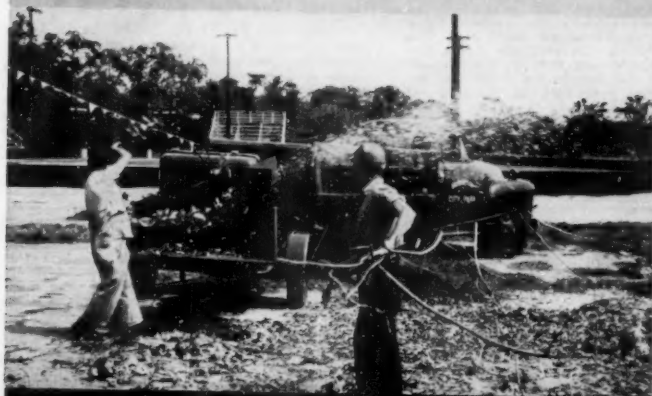
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1. Eliminates or reduces bell holes.
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5. Allows settlement, expansion, contraction.
6. Joints make up tight and stay tight.
7. Joints as permanent as pipe itself.

McWANE CAST IRON PIPE COMPANY
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Sales Offices: Dallas Chicago Kansas City New York Birmingham

FITCHBURG CHIPPERS cut Brush Disposal Costs 25-50%



**Read how Bridgeton, N. J. solved the
problem left by Hurricane Hazel
— 1000 trees down!**

**The Park and Shade Tree Commissions
BRIDGETON, NEW JERSEY**

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June 10, 1955

Fitchburg Engineering Corporation
Fitchburg, Massachusetts

Gentlemen:

The City of Bridgeton has an 1100-acre park, complete with zoo, a raceway, two lakes and a large rhododendron grove.

Hurricane Hazel left our park practically devastated, with a thousand trees down. Our white pine grove was ruined and our picnic areas were a shambles.

Our City Council authorized the purchase of a Model C-612 Fitchburg Chipper, because we were getting nowhere removing the brush from the park.

Since we've had the Chipper we find we can easily chip 8 or 9 truckloads of brush into one dump truck. We've stockpiled the chips and we find that they're in great demand by gardeners and nurserymen, so there's no trouble getting rid of them.

Another thing — because of the feed plate with its safety spring the men can't get hurt by any backthrow from the Chipper.

We save the labor of two men with our Fitchburg Chipper and we have saved several months' time in cleaning up after Hazel. Our Chipper is in frequent use either by us or by the Department of Streets and Roads to remove brush and fallen trees both in the park and along the streets.

Yours truly,

Howard L. Gandy
HOWARD L. GANDY
Superintendent

HLC/sv

FITCHBURG ENGINEERING CORPORATION
FITCHBURG, MASSACHUSETTS

When you want to cut brush disposal costs, investigate a Fitchburg Chipper. There is a model to fit your specific needs.

City after city is saving many manhours and heavy trucking expense—cutting disposal costs 25-50% with these rugged, well-engineered machines. Only Fitchburg Chippers have the patented Safety Spring action which provides equal ease in chipping all sizes of wood to the machine's rated capacity.

Mahwah, N. J. saves 3 men

"Our Fitchburg Chipper was purchased in May 1954. It will take only a short time to pay for itself. We hired 6 men to cut and clean up brush. Now with the Fitchburg Chipper we only need 3 to do the same work. All brush is cut and chipped the same day. This eliminated unsightly heaps along the roadside. In wooded areas the chips are blown back along the roadsides and serve as mulch for forage."

Hartford, Conn. saves manpower-trucking costs

BRUSH DISPOSAL: "Our Highway Division has used our Fitchburg Chipper to clean up the brush and branches along newly developed road areas. By chipping brush, the city saves in use of both manpower and trucking costs." **ROAD CLEARANCE:** "If we get hit again by hurricanes or bad wind storms, we now have an excellent piece of equipment that will enable us to readily open up the streets for emergency traffic by reducing the fallen branches to chips."

A word about Sealed Bids —

Know what you are buying! Bids on Fitchburg Chippers are made on a complete machine ready to operate—NOT a stripped-down model with extra costs to come later. Bids will also be made according to the work capacity of the machine as needed for your specific requirements. Price, alone, is often misleading under the sealed bid system.

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FITCHBURG ENGINEERING CORPORATION

Fitchburg, Mass., Dept. PW-17

Send my free booklet, "CHIPPER TALK," with cutaway color drawings and letters from municipalities, commissions, counties, contractors, tree surgeons.

Name

(Position or Company)

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City State

To order these helpful booklets check the reply card inside front cover.

SEWERAGE AND WASTE TREATMENT

What You Should Know About Trickling Filter Underdrains

20. Specifications for vitrified clay under drain blocks conforming to ASTM standards, suggestions for layout and construction of trickling filter floors, dimensions of standard blocks, channel covers, angles and other fittings are available from the Trickling Filter Floor Institute, c/o Editor, Public Works, 200 So. Broad St., Ridgewood, N. J. Check the reply card and we will forward your request.

Do You Have An Independent Source of Electricity?

27. An independent source of electricity which will supply power for vital services when regular sources fail can be invaluable during emergencies. Check Kohler Bulletin KEP-31 which furnishes data that will help you select the plant best suited for your needs. Many models, 500 watt to 30 Kw, portable and stationary are described. Write the Kohler Co., Kohler, Wis., or use the reply card.

How to Make Better Sewer Pipe Joints

37. How to make a better sewer pipe joint of cement—tight, minimizing root intrusion, better alignment of joint. Permits making joints in water-bearing trenches. General instructions issued by L. A. Weston Co., Dept. P.W., Adams, Mass. Check the reply card.

Submersible Pumps For Municipal Use

185. A new 12-page bulletin that describes the line of BJ submersible pumps is available from Byron Jackson Pump Inc., P. O. Box 2017, Terminal Annex, Los Angeles 54, Calif. Construction and operation of the pumps are covered along with a handy selection chart that gives capacity and head performance.

Engineering Data on Screening Equipment

77. Water, sewage and industrial waste screening equipment is fully described in a 28-page book, No. 2587, offered by Link-Belt Co., Dept. 137, Colmar, Pa. Complete data for the engineer and tables to determine the proper size unit for handling various capacities are included. This valuable, comprehensive booklet may be obtained by checking the reply card.

Helpful Design Data For Sewage Ejectors

81. The application and advantages of pneumatic sewage ejectors are outlined in a new bulletin of the Blackburn Smith Mfg. Co. Inc., Hoboken, N. J. Included are piping diagrams for electrode and float switch controls plus dimensions and layouts for single and duplex systems. Get your copy by checking the reply card.

Stop Sewage Plant Odor Complaints

137. Effective odor control for sewage treatment plants by use of "Orthosolv" is described in literature of Solvay Process Div., Allied Chemical & Dye Corp., 61 Broadway, New York 6, N. Y. Low cost, convenience and safety are important features. Get full data by checking the reply card.

Conveyor Sludge Collector Specifications

210. A new bulletin showing the specifications and components of the type ME Conveyor Sludge Collector is available from Chain Belt Co., Dept. PR, Milwaukee 1, Wisc. Advantages of the collector and photos and line drawings are included. Check the handy reply card for Bulletin No. 315-62.

How and Where to Install A Septic Tank System

270. A manual on modern sewage disposal methods for individual dwellings, camps and rural schools has just been released by Brown Co., 150 Causeway St., Boston, Mass. Location, size of and building the tank, how large a disposal field and laying out the field are discussed. Check the reply card today.

A Handbook of Sewer Cleaning Methods and Materials

44. Complete easy-to-follow directions for every type of sewer cleaning operations and the equipment needed for effective cleaning work is covered in a 48-page booklet issued by Flexible Inc., 3786 Durango, Los Angeles 34, Calif. Full details are provided on power cleaning machines, the SewerodeR, hand tools and all accessories. Water main and culvert cleaning methods are included.

Amvit Mechanical Jointed Clay Pipe

298. The new Amvit jointed vitrified clay pipe in sizes 4 through 24 inches with the true "built in" mechanical joint ready for immediate and easy installation is infiltration and root-proof. Offers better flow and less maintenance and permits deflection and absorbs shocks. It is furnished on all standard fittings and permits immediate backfilling and testing. For literature write to American Vitrified Products Co., National City Bank Building, Cleveland, Ohio, or check the reply card.

Engineering Data on Pneumatic Ejectors

327. Advantages of Shone Ejectors with details on receivers, check valves, pilot valves, installation and important operation and maintenance features are fully described in three new catalogs covering mechanically controlled types, electrode controlled units and the Expelcor pneumatic ejector. Write Yeomans Brothers Co., 2000-1 N. Ruby St., Melrose Park, Ill., or check the reply card.

A Pressure Proven Joint for Concrete Pipe

335. Investigate the Amseal Joint on low pressure concrete pipe for intercepting sewers, inverted siphons, sewage force mains and low pressure water supply lines. This folder is published by American-Marietta Company, Concrete Products Division, 101 East Ontario St., Chicago 11, Illinois. Describes concrete pipe for use in sewer and water lines where maximum operating pressure will not exceed 50 psi. Check the reply card today.

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Salinas, California, finds a single grade of Bitumuls® solves five paving maintenance problems

HERE'S A SITUATION common to most growing cities: annexation of outlying residential developments has vastly expanded the street maintenance job *without* materially increasing available funds. Annexation has not only added to the street mileage, but has "contributed" many sub-standard pavements to the street system, thus adding to the complexity of the job.

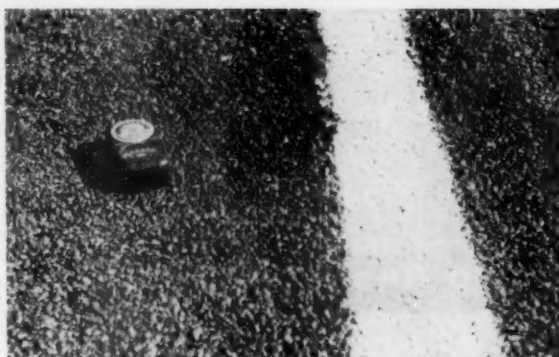
In an effort to solve this problem, these three Salinas men most directly concerned have worked together: Thomas A. Dunne, Director of Public Service; his assistant, Al Rossi; and Harry Adams, Maintenance Supt. Their search for simplicity and standardization led them to look for a versatile asphalt material that would do many jobs. They found it in Bitumuls SS-1, an asphalt emulsion that can be handled and used without heating, in small quantities or large.

Now, stored in a single 25,000-gallon tank, Bitumuls SS-1 is used for: Patching, Tack Coats, Prime, Seal Coats & Surface Treatments, and for Base Stabilization. In addition, Salinas City Forces can also use this same grade of Bitumuls for the new Slurry Sealing; and—at high dilution—for dust-laying on unpaved, outlying roads. All of these jobs can be done with existing equipment: a grader, a "Pulvimixer", a water wagon, two distributors, and a roller.

The obvious economies resulting from the use of this one material for all these jobs merit investigation by paving maintenance men everywhere, regardless of the size of their community.

There's a Bitumuls man near you who can supply details. *Call him, today, or write: American Bitumuls & Asphalt Co., 200 Bush St., San Francisco 20, Calif.*

(Right), SALES ENGINEER Bob Rideil, far left, of American Bitumuls & Asphalt Co., discusses plans with Tom Dunne, Director of Public Service for Salinas, and his assistants. At far right is a partial view of the 25,000 gal. storage tank. (Below), EVEN SCHOOL YARDS are given stabilized bases with Bitumuls SS-1.



(Top), "PULVIMIXER" reworks old pavement that has been scarified and bladed in restabilization operation. Distributor applies Bitumuls at $\frac{1}{4}$ gal./sq. yd. per inch of depth. (Center), DISTRIBUTOR applies prime on a waterbound base, using Bitumuls SS-1 diluted (2 parts SS-1 to 1 part water) at 0.3 gal./sq. yd. of dilution. (Bottom), HERE'S A CLOSE-UP of the finished texture of a Bitumuls SS-1 Seal Coat pavement.



To order these helpful booklets check the reply card inside front cover.

Modern Methods and Materials For Jointing Sewer Pipe

402. In a compilation of reprints and related supplementary material, the Atlas Mineral Products Co., Mertztown, Pa., presents a comprehensive review of all types of sewer jointing materials and methods. You will find this interesting and informative reading. Get a copy by checking the reply card.

Portable, Standby Or Continuous Power

440. Generators and power plants for emergency, portable continuous power are described fully in literature available from Katolight Corporation, Box 891-107, Mankato, Minnesota. Information on motor generator sets, high frequency changers and independent generators up to 400 K. W. is included. Check the reply card today.

Data on Adjustable-Speed Magnetic Drives for Low-Lift Pumps

465. A catalog is available from Electric Machinery Mfg. Co., Minneapolis 13, Minn. that tells all about E-M Vertical Synchronous Motors and Magnetic Drive Units. Engineers check the reply card for information on this equipment for sewage pumps.

Butterfly Valves For Water and Sewage Treatment Plants

507. Rubber seated butterfly valves are described and illustrated in a new two-color Bulletin No. 5603, available from F. B. Leopold Co., Inc., 227 So. Division St., Zelenople, Pa. Complete details on the performance and construction features of the valve are included. Check the reply card.

Flow Tube For Metering Water and Sewage

541. The Gentile "Flow Tube" is described fully in Bulletin FT available from Foster Engineering Co., 835 Lehigh Ave., Union, N. J. Advantages, applications, drawings, head loss curves and other curves showing differentials for various ratios and velocity heads are included. Check the reply card.

Theory of Controlled Digestion With Floating Cover Tanks

88. In an excellent 40-page booklet, an authoritative discussion of digestion theory and practices, including design, operation and economics is presented by the Pacific Flush Tank Co., Chicago 13, Ill. Complete data are given on the use of floating covers, together with details on tank construction, piping and control chambers. Requests for this valuable booklet to made on business letterhead.

A Precast Concrete Filter Bottom

394. The Criscrete unit is precast prestressed concrete built monolithically spanning the entire width of the filter in one piece. It requires 6 in. overall depth in the filter and employs non ferrous nozzle liners. For complete information on this filter unit get literature available from MCG Co., 1771 W. 5th Ave., Columbus 12, Ohio, by checking the reply card.

Use The Reply Card

Getting Improved Sludge Dewatering With Non-Clogging Vacuum Filters

425. Latest information on the Komline-Sanderson "Coilfilter," which features non-clogging, permanent filter media to obtain constant output and low operating cost is presented in illustrated Bulletin No. 102 by the Komline-Sanderson Engineering Corp., Peapack, N. J. Be sure to investigate this improved method of sludge dewatering. Check the reply card today.

V-Notch Chlorinators For Water and Sewage Plants

590. Bulletins on the Series A-711 and the Series A-712 chlorinators are available from Wallace & Tiernan Inc., 25 Main St., Belleville 9, N. J. Covered in the literature are design features that include operation, installation and maintenance. Simplified flow diagrams in color are included showing the operation of the units. Class, capacities, feed ranges and electrical requirements are described in the technical data section. For your copies, check the reply card.

CONSTRUCTION EQUIPMENT AND MATERIALS

For Fast, Smooth Pipe Cuts

68. Descriptive literature on the Reed 4-wheel hinged pipe cutter which operates in close quarters, gives quick, easy right-angle cuts, and is available from Reed Mfg. Co., Erie, Pa. Check the reply card.

"Encyclopedia" on Bulldozers

97. Every size and style of bulldozer made by Caterpillar Tractor Co., Peoria 8, Ill., is shown in a 36-page booklet, Form 30461. Cutaway views showing details, important components of hydraulic and cable controls, attachments such as brush, root and rock rakes, treedozers and stumpers are also included. Get this interesting publication by checking the coupon.

Makes Underground Pipe Installation Easy

115. One-man operated hydraulic pipe pusher, pushes pipe through ground under streets, sidewalks, lawns and other obstacles. Pays for itself in man hours saved on first few jobs. For complete facts ask for Form E-213 Greenlee Tool Co., Rockford, Ill.

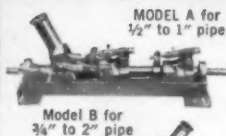
Now Every Municipality Can Own a Trencher

173. The low cost of the Blackhawk Trench Hog, a tractor-mounted ladder type trencher makes it profitable for many municipalities to own their own trencher. Be sure to investigate this versatile machine which digs trenches to 7 feet deep, 20 inches wide. Illustrated bulletin available from Arps Corp., New Holstein, Wis. Just check the reply card.

(Continued on page 56)

Only the Trojan Pipe Puller & Pusher

gives you continuous action
No Resetting of Grip!



Model A for
1/2" to 1" pipe



Model B for
3/4" to 2" pipe



NEW AIR POWERED
Model B

Does all the work for you.
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in installing or renewing
pipe under pavement

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Model A weighs 65 lbs.—requires only 5' trench. One man can easily install the average service. 15 tons of pushing pressure possible.

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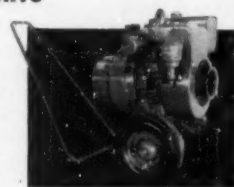
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25 kw. emergency diesel model.

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() Please send literature, specifications, prices on Universal Electric Plants for municipality services.

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Youth center auditorium at state fairgrounds in Columbus, Ohio. Note walls of cement block, concrete and brick.



Multiple unit Butler building located on the Taylor County Fairgrounds in Abilene, Texas.



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... they represent the lowest cost way to build well. And they can be used for almost any purpose.

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nificent public showplace with walls of glass, concrete and metal.

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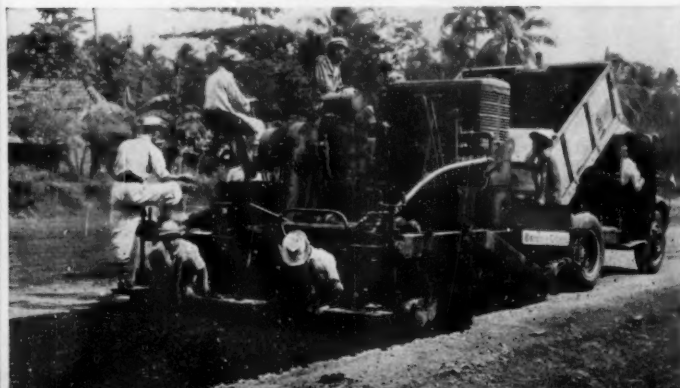
An International UD-18A powers the cyclone dust collector and a UD-1091 operates the dryer in this Barber-Greene Model 848 bituminous plant owned by Hallet Construction Company, Ames, Iowa.



Rock County, Wisconsin, is now in the paving business with this Barber-Greene Model 848 Travel plant. Towing loader uses an International UD-350 and the mixer uses a UD-18A.



100% International power units and trucks is the rule for Hazelmere Bituminous Co., Fairmont, Minn. Their Barber-Greene Model 848 continuous-mix plant is powered by a UD-18A and a UD-24.



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These owners of Barber-Greene bituminous plants and pavers would give you these hard dollar reasons: Internationals have more features that pay off in lower production costs—and unsurpassed parts and service support for your convenience.

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Even in Djakarta, Indonesia, the preference is for International power units. Here a UD-6 powers the government-owned Barber-Greene Model 879-A Finisher.



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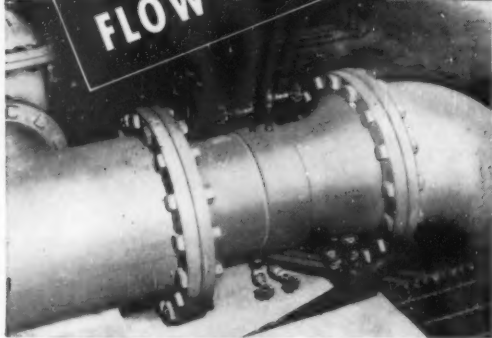
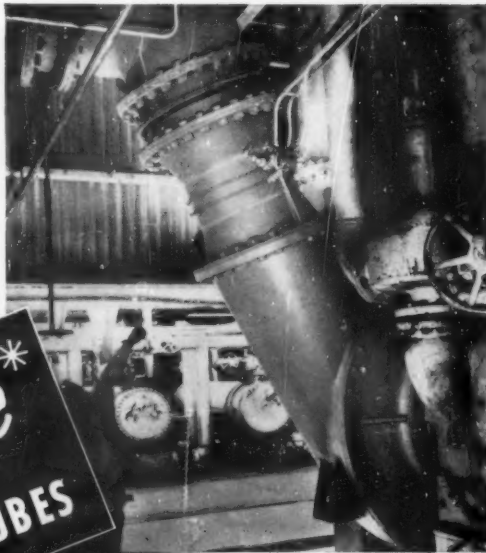
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Gentile Flow Tubes are short. They need only minimum straight runs entering and following, and can be installed at practically any accessible point where flow conditions are reasonably steady.

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209. Complete information is available from The Jaeger Machine Co., Columbus 16, Ohio on this 2-stage, oil-cooled rotary compressor. Features include 80% fewer moving parts, up to 30% less weight, vibrationless operation and 100° cooler air. For full details check the reply card.

Handbook of Castings For All Public Works Construction

220. Every type of construction casting needed by engineers and contractors in the public works field will be found in a 136-page catalog issued by Neneah Foundry Co., Neenah, Wis. Detailed illustrations and complete tables of dimensions will help the designer and materials buyer. Get your copy of this valuable catalog by checking the reply card today.

Booklet Shows Design of Pre-Engineered Steel Buildings

271. Pre-engineered Butler steel buildings are available in every size, type and design to meet your building needs. In a helpful 16-page booklet you will find details on several basic designs and an unlimited variety of door, window and interior treatments; answers to your questions on construction and erection; and many illustrations of typical uses. Use the reply card or write to Butler Mfg. Co., Kansas City, Mo.

Davis Back-Hoe and Davis Loader

312. Literature is available from Mid-Western Industries, Inc., 1009 S. West St., Wichita, Kans., describing the new Davis backhoe and Davis loader. The backhoe can dig at right angles and to a depth of 13 ft. and detaches in 5 minutes. Both units are available for most popular makes of tractors.

Use The Reply Card

Power Shovel, Crane and Backhoe All in One Unit

441. A completely hydraulic backhoe, shovel loader and crane all in one unit is described in literature available from the Badger Machine Co., Winona, Minn. Also information on front-end loaders, truck and trailer mounted hydraulic backhoes and various attachments that are useful for contractors, municipal and county engineers and state highway engineers. Check the reply card.

Self-Propelled Ditching Machines

438. Information on a self-propelled one man operated ditching machine, model 524 T, and a new midget ditcher, model 4 T, for light construction is now available from the Vermeer Mfg. Co., Pella, Iowa. The Model 524 T digs 8 to 24 inches wide and down to 6 feet deep, while the model 4 T digs 6 to 14 inches wide and down to 4½ feet deep. Full data on these ditchers available by checking the reply card.

Complete Bulletin On Municipal Supplies

473. Everything from leak locators to street signs is listed in the big 108-page bulletin "Municipal Supplies" published by Darley. Hundreds of different items for all city departments are included. Get your copy of Bulletin No. 155 from W. S. Darley & Co., 2814 Washington Blvd., Chicago 12, Ill., by checking the reply card.

Versatile Oliver Diesel Wheel Tractor

519. Powerful wheel tractor for construction and maintenance work is described fully in a catalog available from The Oliver Corp., 400 West Madison St., Chicago 6, Ill. Specifications, engine data and optional equipment are included. Check the reply card.

Steel Cabs Designed to Fit Most Any Tractor



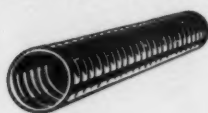
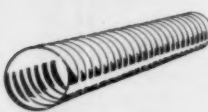

582. Cabs that assure operator comfort winter or summer, will fit most popular makes of front end loaders, back-hoes or combinations. The cab consists of heavy gauge steel top and supports with heavy duty canvas side and rear curtains, safety glass windshield and side windows of vinyl plastic. For details and prices check the reply card or write Northeast Equipment, Inc., 9 Brookfield St., Worcester, Mass.

How To Select the Right Sewer Structure

The problem of selecting the correct type of sewer structure is simply a matter of choosing the product that best meets your requirements. The wide variety

of Armco Sewer Structures makes this selection easy.

This table tells what Armco Product does the most economical job under various conditions.

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All Armco Sewer Structures combine the proved strength of corrugated metal pipe with the added advantage of watertight joints.

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plied to your needs write Armco Drainage & Metal Products, Inc., 3297 Curtis Street, Middletown, Ohio. Subsidiary of Armco Steel Corporation. Export: The Armco International Corporation.

ARMCO SEWER STRUCTURES



To order these helpful booklets check the reply card inside front cover.

Convenient Data on Tandem and 3-Wheel Rollers

449. This manual covers everything on the variable weight, 5-8, 8-10, 8-12 and 10-14 ton tandem rollers and on the standard and variable weight, 8, 10, 12, 14 ton and 8-10, 10-12, 12-14 ton 3-wheel rollers. Covered are the frame, transmission, final drive, front end and operator's controls. The designs, construction, performance and service of the rollers are fully outlined. There are plenty of illustrations along with a complete set of specifications for each roller model. Available from Huber-Warco Co., Marion, Ohio, or check the reply card.

Catalog on John Deere Tractors and Equipment

588. Information and specifications on the John Deere "420" crawler and industrial tractors are fully covered in catalog from Deere & Co., 3300 River Drive, Moline, Ill. Attachments such as snow plow blades, rear-mounted blades, mowers and angling dozers are described. Check the reply card.

Complete Line of Concrete Gunning Equipment

200. A 16-page catalog that gives complete details, specifications and operating capacities of concrete gunning equipment and answers to many of the questions asked about air placed or gunned concrete is available from Air Placement Equipment Co., 1009-11 West 24th Street, Kansas City 8, Mo. Also included are several pages of actual job application photographs showing the many and varied uses of this modern equipment. Check the handy reply card for your copy of this catalog.

Tracto-Loaders For Fast Material Handling and Excavating

600. Tracto-Loaders with capacities from $\frac{1}{2}$ cu. yd. to $1\frac{1}{4}$ cu. yd. are described fully, in a 2-color catalog available from Tractomotive Corp., Deerfield, Ill. General purpose material handling and excavating loading in confined areas are jobs performed by these machines. Check the reply card.

STREETS AND HIGHWAYS

Bitumuls Paving Handbook Full of Useful Data

23. The latest edition of the Bitumuls Paving Handbook covers a wealth of practical data on paving methods and materials, road and airport paving specifications and construction details, complete tabular data on asphaltic binder applications and aggregate requirements, condensed Asphalt Institute specifications plus data on Laykold compounded asphalts for flooring, tennis courts, protective coatings and waterproofing. You can have a copy by checking the reply card. American Bitumuls & Asphalt Co., 200 Bush St., San Francisco 20, Calif.

How to Prepare and Maintain Roadways With Calcium Chloride

65. "The Calcium Chloride Road," is the name of a new 24-page two-color catalog issued by the Columbia-Southern Chemical Corp., 632 Fort Duquesne Blvd., Pittsburgh 22, Pa. Included are sections on dust control, gradation, placing and mixing materials and shaping. General information on spring, summer and fall maintenance is also provided. Check the handy reply card.

Levels Sidewalks and Curbs Quickly and Easily

29. How the Mud-Jack Method for raising concrete curb, gutter, walks and streets solves problems of that kind quickly and economically without the usual cost of time-consuming reconstruction activities—a bulletin by Koehring Company, 3026 W. Concordia Ave., Milwaukee 16, Wis. Check the reply card.

Uses and Erection Data of Barrier Beam Guard Rail

46. Typical installations, erection instructions, specifications, curving data and physical properties of the barrier beam guard rail are fully covered in the catalog available from United Steel Fabricators, Inc., Wooster, Ohio. Plenty of photographs and drawings are included. Check the reply card.

The Principles of Compaction by Vibration

48. Compaction specifications that can't be met with ordinary compactors are no problem to the new Essick vibrating rollers. Complete descriptive literature explaining the principles of compaction by vibration and the Essick vibrating roller is available from Essick Mfg. Co., 1950 Sante Fe Ave., Los Angeles, Calif. Check the handy reply card.

Help in Selecting Motor Graders

145. A 16-page catalog, No. 380, released by The Galion Iron Works & Mfg. Company, Galion, Ohio, describes the numerous construction and operating features of the Galion Model 503 Motor Grader. Optional equipment includes hydraulic shiftable mold-board, front-end scarifier, "V" and straight snow plows, rear-end bucket loader and bull-dozer. Check reply card for full data.

Getting Specified Density In Granular Bases and Fills

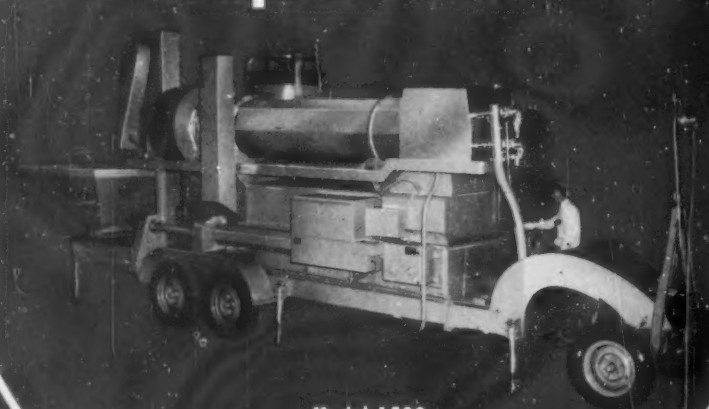
188. Vibratory compactors offer the means for getting specified density in rock, slag, soil-bound macadam, gravel and sand base courses. Just one pass may suffice. Get complete information from Jackson Vibrators, Inc., Ludington, Mich. See how adaptable compactor units handle a variety of compaction needs. Check the reply card today.

How the "Payloador" Helps Public Officials

190. An attractive booklet "Getting More for the Tax Dollar with Payloadors" makes worthwhile reading for every public official in charge of construction and maintenance of roads, streets, and utilities. You will find illustrations and data showing dozens of ways the "Payloador" is used by cities, counties and states, plus convenient specifications on seven models. Check the reply card or write Frank G. Hough Co., 761 Seventh St., Libertyville, Ill.

NEW

WYLIE ROADMASTER Asphalt Plant




Model 1520

- ★ 15-20 Tons Hourly Capacity
- ★ Completely Mobile

- Fully automatic batching and asphalt metering cycle
- Rotary dryer with forced draft
- Twin-shaft pugmill with enclosed oil bath gear box

- Enclosed bucket elevator and reciprocating feeder
- 400 gallon asphalt tank
- Cyclone type dust collector


The "1520" meets the demand for a complete self-contained, mobile plant, ready to operate in minutes right at the jobsite. Available also as a skid-mounted unit, with gasoline, diesel or electric power. The Roadmaster is the machine asphalt users have been waiting for — the asphalt plant that has everything.

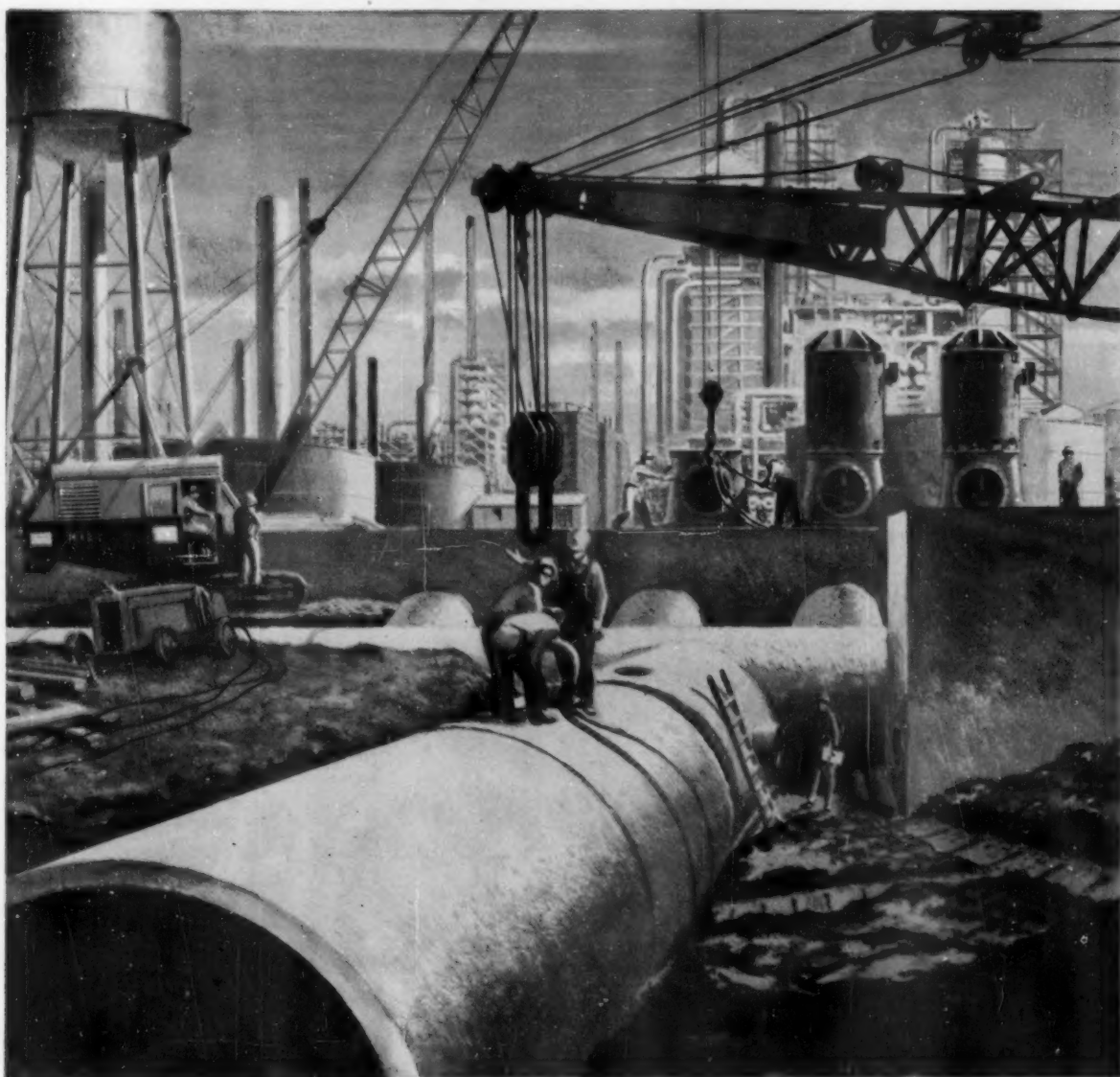


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WYLIE MANUFACTURING CO., INC.

P. O. Box 7086, Oklahoma City 12, Okla.





Where OIL and WATER do mix!

It takes a staggering amount of water to run an oil refinery such as the one recently built for the Tidewater Oil Co. at Delaware City, Delaware. Specifications required twin 78" LOCK JOINT REINFORCED CONCRETE CYLINDER PIPELINES to supply water to this plant. The combined capacities of these two lines would satisfy the normal requirements of a city of over two million population.

Only the most rugged and dependable type of pipe could be trusted to handle such volumes of water within the limited confines of a multi-million dollar plant. Yet Tidewater authorities are confident of the durability and safety of the refinery's Lock Joint supply lines because these characteristics are built into every Lock Joint pressure pipe through conservative design, careful choice of materials and expert workmanship.



LOCK JOINT PIPE CO.

East Orange, New Jersey

Sales Offices: Chicago, Ill. • Columbia, S. C. • Denver, Col. • Detroit, Mich. • Hartford, Conn. • Kansas City, Mo.
Pressure • Water • Sewer • REINFORCED CONCRETE PIPE • Culvert • Subaqueous

To order these helpful booklets check the reply card inside front cover.

How to Solve the Brush Disposal Problem

277. Fitchburg Chippers, engineered to solve the brush disposal problem reduce troublesome brush and trimmings to tiny, easy-to-dispose-of chips. Several models are available to meet your needs. May be mounted on truck body or on trailer, tractor or jeep. Full details in interesting, profusely illustrated 16 page bulletin. Write Fitchburg Engineering Corp., Fitchburg, Mass., or check the reply card for your copy.

Black Top Road Maintenance and Construction Equipment

286. A highly informative, 36-page catalog, covering the entire field of highway and road maintenance equipment has been released by Littleford Bros. Inc., East Pearl St., Cincinnati 2, Ohio. Units described and illustrated include distributors, supply tanks, sprayers, brooms, rollers, heater-planer, asphalt kettles and accessory tools. Check the handy reply card for your copy of this valuable catalog.

What Equipment is Needed By Modern Community Services

328. The importance of modern equipment in work programs is graphically illustrated in the 16-page booklet "Allis-Chalmers Offers New Economy for Villages, Townships, Counties, Cities, States, Federal." Action photographs span the range of community projects and illustrate tractors, scrapers, graders, power units and their multi-purpose attachments. Get this handsome booklet and review your needs today. Allis-Chalmers Mfg. Co., Tractor Div., Milwaukee 1, Wis. Check the reply card.

Case Histories of the Combination Tractair-Air Compressor

585. Four Tractair case histories are covered in this literature issued by the Le Roi Div., Westinghouse Air Brake Co., Milwaukee, Wisc. They are printed in three colors and using illustrations, describe the all-purpose Tractair as used on air application jobs, with or without the more than a dozen attachments available. Check the reply card.

The Modern Approach to the Brush Problem

222. Eliminate your brush disposal problem by using an Asplundh Chipper. For complete information on what the Chipper can do, how it can save on costs, various types available and other outstanding features write to Asplundh Chipper Co., 505 York Road, Jenkintown, Pa., or check the reply card.

How To Build Stabilized Heavy Traffic Pavements

233. A 16-page booklet published by Seaman-Andwall Corp., Milwaukee, Wis., shows how low cost, local materials may be utilized in the construction of heavy duty pavements. Many illustrations and well-written text give full instructions on materials and construction methods for subgrades, subbases and base courses. A worthwhile booklet for every highway engineer. Check reply card for copy.

What You Should Know About Soil Sampling

255. Acker Soil Sampling Catalog No. 25 contains a complete and thorough collection of information about soil sampling in all types of sub-surface conditions. Modern sampling techniques are discussed together with recommendations as to tools and accessories. Write Acker Drill Co., Inc., Scranton, Pa., or check the reply card.

"A Complete Package" of Road Building Equipment

261. A new catalog describing the road widener, trench roller and base paver has been released by Blaw-Knox Co., Construction Equipment Division, Pittsburgh 38, Pa. Illustrations, specifications and operation procedures are fully covered. Check the reply card today.

Traffic Paints

That Last a Long Time

274. Traffic paints with the Parlon-Pentaly formula, that has long wear, dries quickly, has excellent adhesion, provides an excellent bond for glass beads and can be applied by flow or spray is described in a bulletin just released by Cellulose Products Dept., Hercules Powder Co., Wilmington 99, Del. Check the reply card today for your copy.

New ReflectORIZED Sign Faces Refurbish Old Traffic Signs

292. Get complete details on new "EZ-On" traffic sign faces ready for immediate shipments. ReflectORIZED faces cost only a fraction as much as new signs and are easily attached to existing traffic signs. Grace Sign & Mfg. Co., St. Louis 18, Mo.

Equipment For Highway Stabilization

363. The Roto-Mixer and Preparator are machines available for low-cost road building and stabilization. For operation, uses and specifications get literature from Road Machinery Div., Wm. Bros. Boiler & Mfg. Co., Minneapolis 14, Minn., or check the handy reply card.

A Modern Maintenance Tool For Compaction

523. Tampers that are the perfect answer to maintenance problems for street and highway departments, contractors, utilities and airports are covered fully in bulletin just released by Jay Mfg. Co., 168 Hosack St., Columbus, Ohio. For information on how to put patches in to stay, tamp where a roller can't and work in all kinds of weather, check the reply card.

Detailed Data and Prices on Optical Repeating Transits

583. Optical repeating transits are described fully in literature available from Wild Heerbrugg Instruments, Inc., Main St., Covert St., Fort Washington, N.Y. Check the reply card for information on design, operation and prices.

Literature on 1957 Chevrolet Utility and Maintenance Trucks

579. Light and medium duty 1957 Chevrolet trucks are described fully in literature available from Chevrolet Div. of General Motors, Detroit 2, Mich. New features include modern versions of Thriftmaster and Jobmaster 6's and the short-stroke Trademaster V8's and the 283 cu. in. Taskmaster V8's. Also optional features are the Hydra-Matic and Powermatic transmissions. Check the reply card.

TASSCO TOMCAT ALL ALUMINUM

Beauty, practicability and economy go hand in hand in every community where specifications read: TASSCO TOMCAT. This virtually indestructible, maintain-

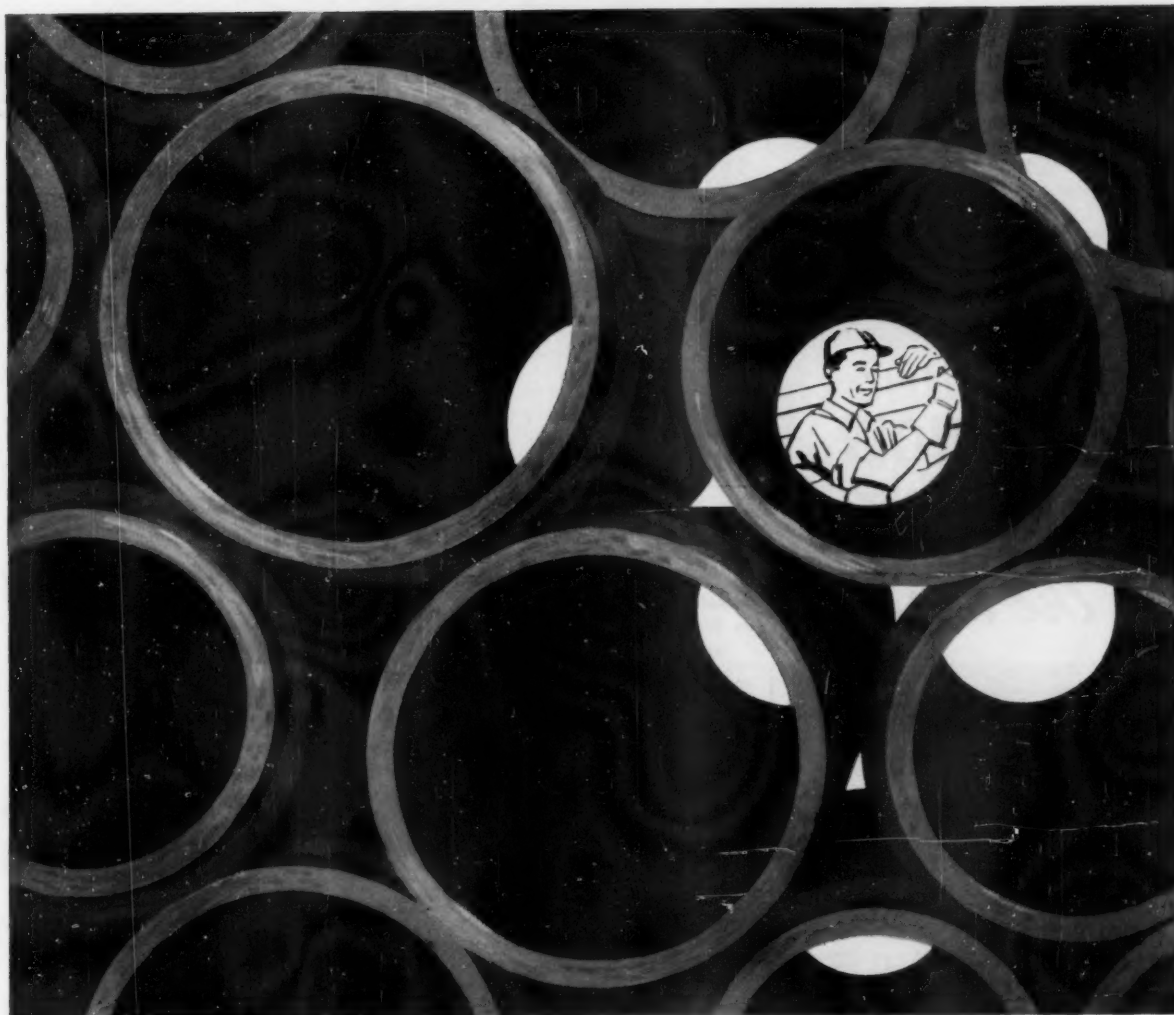
ance-free sign is most pleasing and attractive in appearance. More than that . . . it has over three times the visibility of ordinary signs both by day and by night.

For information on the Tassco Tomcat, write for the Tassco color brochure #57.

The Sign of **TASSCO** Traffic Safety

TRAFFIC & STREET SIGN COMPANY, 84 FOUNDRY ST., NEWARK 5, N. J.

PUBLIC WORKS for January, 1957



Modern building codes include **BERMICO[®]** bituminized fibre pipe — *modern pipe for modern living*

Far-sighted code authorities everywhere are recognizing the advantages to their communities of modern, light-weight, root-proof Bermico Sewer Pipe—the dependable pipe *that comes in 8-foot lengths for easier installation.*

Already certified in communities all over the country and recently given the stamp of approval of the Southern Building Code Congress, Bermico is widely recognized today as the Modern Pipe for Modern Living.

Made of tough cellulose fibre impregnated with coal-tar pitch, it

resists acids and alkalis, is strong, and stands up under temperature changes and soil settlement—for lasting protection against failure in sewer lines and drainage.

Available in all diameters from 2" to 6", Bermico is the only bituminized fibre pipe with a complete line of fittings—Wyes, Tees, and Bends—made of the same material. You can't buy and install root-proof pipe for less.

Your community will be grateful when you modernize your plumbing code to include Bermico, the modern pipe for modern liv-

ing. Thousands already have. For technical information, write Dept. BE-1, Brown Company, 150 Causeway Street, Boston 14, Mass. (Mills: Berlin, Gorham, North Stratford, N. H.; Corvallis, Ore.)



To order these helpful booklets check the reply card inside front cover.

*When this Nameplate
goes into place...*



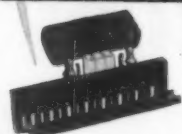
**YOU KNOW
YOU HAVE
the Best**

**ROBERTS FILTER
MANUFACTURING CO.**

**640 COLUMBIA AVE.
DARBY, PA.**

**FAST, ACCURATE
TESTS for pH,
CHLORINE, FLUORIDE
with**

TAYLOR COMPARATORS



**Help Control
Coagulation,
Chlorination,
Algae,
Foaming**

Get dependable data for plant or field operations in a matter of minutes by making on-the-spot tests for pH or chlorine with handy, lightweight Taylor Comparators. No technical knowledge or experience is required... to test, simply fill 3 test tubes with sample, add reagent to middle tube and move color slide across until colors match. You then read values direct from slide. Fluoride sets also available.

COLOR STANDARDS GUARANTEED

Be sure to use only Taylor reagents and accessories with Taylor Comparators to assure accurate results. All Taylor liquid color standards carry an unlimited guarantee against fading.



SEE YOUR DEALER for Taylor kits or immediate replacement of supplies. Write direct for **FREE HANDBOOK**, "Modern pH and Chlorine Control". Gives theory and application of pH control. Illustrates and describes full Taylor line.

W. A. TAYLOR AND CO.
7304 YORK RD. • BALTIMORE-4, MD.

Cut Road Building Costs With A Tamping-Leveling-Finisher

173. For a full description of roadbuilding methods with a tamping-leveling-finisher which lays a smooth mat without forms, tamping and compacting to desired grade, get Bulletin 879-A from Barber-Greene Co., Aurora, Ill. Check the reply card today.

Portable Hot Asphalt Paving Repair Unit

250. Maximum economy in paving repair and maintenance is claimed for the compact "Patchmobile" which has a rotary tube continuous dryer, batching hopper for accurate proportioning, twin hot asphalt tanks, heat jacketed pugmill, tool heaters and hand spray bar. Get latest data from Wylie Mfg. Co., 5926 N. W. 39th St., Oklahoma City 12, Okla. Use the reply card.

Advanced Tractor Design Gives Better Performance

399. The Ford Tractor offers 4-wheel stability, built-in hydraulic system, power take-off, as well as greater power, performance and economy. A complete booklet describes five tractor models in two power series, showing the latest in advanced tractor design and including many applications of equipment for saving time and money. For your copy check the reply card or write Tractor and Implement Division, Ford Motor Co., Birmingham, Mich.

Complete Information on Wain-Roy Back Hoe

459. Complete information on a self-contained back hoe that is designed to fit Payloader tractor-shovels and International crawler tractors is available from Wain-Roy Corp., Dept. C, Hubbardston, Mass. Included are specifications, types and many exclusive features. Check the reply card today.

Information on 5 Versatile Tractors For Municipal and County Work

484. Tractors that find scores of highly efficient applications in construction, municipalities, utilities and related fields are described fully in a catalog just released by Massey-Harris-Ferguson, Inc., Industrial Div., Quality Ave., Racine, Wisc. Models, specifications, attachments and uses are covered.

IHC Crawler Tractors For Highway Construction

491. Information on the new International TD-6, TD-9, TD-14 and TD-18 diesel crawler tractors is contained in 8-page, 2-color booklet available from Consumer Relations Dept., International Harvester Co., 180 N. Michigan Ave., Chicago 1, Ill. Mechanical features and specifications, engine power, and operation are fully covered. Check the reply card.

The Crawler Tractor, Backbone of Construction

504. A new 12-page catalog published by American Tractor Corp., Churubusco (Ft. Wayne), Ind., graphically illustrates how and where the 30 to 60 hp TerraTrac tractors fit in the construction picture. Illustrations of the complete tractor line, plus a complete selection of matching loaders, dozers, backhoes, scarifiers and winches are included. Check the reply card.

Manual on Apparatus For Tests of Soils, Concrete and Asphalt Materials

510. The new 128-page catalog just released by Soiltest, Inc., 4711 W. North Ave., Chicago 39, Ill., contains descriptions and illustrations of over 1350 items of apparatus for engineering tests of soils, concrete, asphalt and construction materials. It lists items ranging from pocket penetrometers for soil, to pavement deflector instruments for asphalt, and 200,000 pound compression testing machines for concrete. Check the reply card today.

Complete Line of Earth Boring Machines

591. A 16-page illustrated catalog on the Hydrauger line of boring machines has been released. Field operation photos and views showing embankment drainage and pipe line installation are included in this material available from Hydrauger Corp., Ltd., 681 Market St., San Francisco, Calif.

STREET LIGHTING AND TRAFFIC CONTROL

Investigate These Street Lighting Standards

54. You can get complete data on Kerigan factory-built "Weldforged" street lighting standards, brackets and mast arms by using the handy reply card. Check these strong, well designed, inexpensive steel standards for practical street and highway lighting. Handsome 26-page folder includes data sheets on floodlighting and area lighting applications. Kerigan Iron Works, 1033 Herman St., Nashville, Tenn.

Engineering Data on Aluminum Lighting Standards

256. Latest designs and applications of all-aluminum, seamless, tapered lighting standards, traffic signal posts and elliptical lighting brackets plus detail drawings and mechanical specifications are provided in a comprehensive 16-page bulletin issued by Pfaff & Kendall, 84 Foundry St., Newark, N. J.

A Guide to Effective Traffic Safety

468. A 20-page catalog with hundreds of illustrations of all types of signs used on highways and in motor and pedestrian traffic areas is offered to public works officials by Traffic and Street Sign Co., 84 Foundry St., Newark 5, N.J. This convenient reference covers all your sign needs.

For Prompt Service Use The Reply Card

REFUSE COLLECTION AND DISPOSAL

Increasing the Efficiency of Bulk Rubbish Collection

177. Strategically spotted bulk containers can be handled by one man operating a Dempster-Dumpster equipped truck. Get full details of this cost-saving system of rubbish collection, as used by many cities to increase efficiency and eliminate unsanitary conditions. Write Dempster Brothers, Inc., 952 Dempster Bldg., Knoxville 17, Tenn., or use the handy reply card.

Catalog on the Flynn and Emrich Incinerator Stokers

180. This catalog describes the Flynn and Emrich Incinerator stokers as to design, feeding capacities and loadings. Plenty of drawings of the stokers and photographs of incinerator plants under construction and in operation are included. Also, there is a good section on the incinerator history. Check the reply card today for catalog No. 1702 from Flynn and Emrich Co., Holliday and Saratoga Sts., Baltimore 2, Md.

New M-B Packer Body Designed for Maximum Payload

309. The M-B Packer Body, designed to provide maximum payload on a minimum size, low-cost truck, features effective, simple compaction system; provides easy loading, positive discharge, all safety features. Available in 12-14-16, 20, 24 cu. yd. capacities. Get all the facts from M-B Corp., New Holstein, Wis.

New Roto-Pac Features Speed Refuse Collection

50. Features of the Roto-Pac refuse collection unit, which include automatic continuous loading and packing with increased power to provide for larger loads in the same size body, are described in bulletins issued by City Tank Corp., 53-09 97th Pl., Corona, L. I. Check the reply card now to learn how your collection problems can be eased.



Wayne Richardson

L. E. Cunningham

"Here's why our city installed its sixth BJ Submersible"

*Says L. E. Cunningham,
Mayor of this
progressive
midwestern city*

WELCOME TO BELVIDERE ILLINOIS CITY OF INDUSTRIAL ADVANTAGES

Facts about Belvidere, Illinois

A friendly city of 10,000, Belvidere is located 75 miles northwest of Chicago. Its industrial advantages include abundance of water, skilled labor pool, good plant sites, low tax and utility rates, and excellent educational and recreational facilities. It is served by the Chicago and Northwestern Railroad and 26 major truck lines.

Facts about the BJ Submersible

The BJ Submersible operates completely submerged in water at any depth. This sealed, submerged unit needs no pump house and is unaffected by weather extremes, floods or dust. The BJ Submersible requires no field adjustments. Normally gives more than 20 thousand pumping hours before service is required. Silent and vibrationless.

"A dependable, protected water supply system is vital to the future growth of both our residential and industrial areas.

In the past our wells were pumped by surface motor deepwell turbines requiring pump house protection and special maintenance. In 1951 Wayne Richardson, our Waterworks Superintendent, working with R. Anderson, Engineering, replaced an old deepwell turbine with a modern Byron Jackson Submersible.

Our experience with this completely submerged pump was so satisfactory that we converted all our wells to submersible operation, having just completed the installation of the sixth unit. The combined capacity of all these units is now 5 MGD with storage facilities for 1,700,000 gallons.

The people of Belvidere are now assured a pure water supply that is completely safe from flood or other disaster conditions. And our people also benefit as taxpayers since routine maintenance is eliminated and no costly, space-consuming surface structures are necessary. Byron Jackson Submersibles have provided us with the answer to all our pumping problems."

SINCE **BJ** 1872

Byron Jackson Pumps
Incorporated

A Subsidiary of Borg-Warner Corporation
P. O. Box 2017A, Terminal Annex • Los Angeles 34, California

This Proved Method is Whipping Costly....Unsanitary Refuse Conditions in City-After-City!

AFTER AGE-OLD CONTINUOUS BATTLE with costly, unsightly and unsanitary refuse handling and collection conditions in our cities, man is finally winning out—thanks to the development of the remarkable Dempster-Dumpster equipment and the Dempster-Dumpster System.

Here is a method that provides a mobile Dempster-Dumpster, operated by only one man, the driver, to serve scores of big steel detachable containers, one-after-another!

All conventional and inadequate cans, crates, boxes, drums, etc. are removed from the commercial areas and eliminated! Big Dempster-Dumpster depositories, each with self-latching doors, are placed at strategic locations behind department stores, food markets, business establishments, hotels, schools, hospitals, housing and apartment areas, etc.

As any and all things are discarded, they are placed in a nearby Dempster-Dumpster Container—never to be touched again by human hands—never to cause fire or health hazards—never to litter the streets and alleys—never to become the feeding and breeding place for rats, flies and scavengers—never to demand large expenditures for re-handling and collection by crews for hauling and final disposal at the dump!

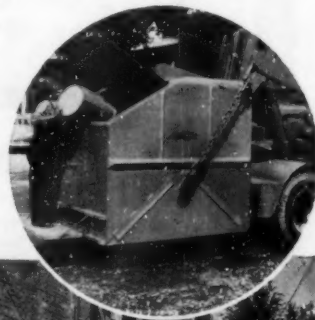
MONAHANS, TEXAS (population 6,311) is one of the recent cities to install the Dempster-Dumpster System. Typical of the conditions there before and after this modern system was installed are shown in snapshots below. One Dempster-Dumpster serves 27 containers during four night hours. In the daytime, Dempster-Dumpster with Kollector Container collects residential refuse (see photo at right). Equipment investment will be amortized in 3 years by the city from actual savings.

Savings produced by the Dempster-Dumpster System in almost 100 cities where it has thus far been installed usually range from 50¢ to 90¢ on the dollar, depending on the equipment and method this modern system replaced.

Average small city figures labor savings alone pays for the equipment in the Dempster-Dumpster System in nine months to four years, depending on the installation required.

To determine the number of these big containers desired, each city calls on Dempster Brothers' engineers to make a survey. This survey which is made at no cost or obligation to the city, determines correctly the number and sizes of containers needed, the recommended locations of containers and the amount the cost of refuse handling can be reduced.

Any city in the country, regardless of size, can expect to eliminate unsanitary rubbish conditions in the commercial areas—and at a tremendous reduction in costs—with the Dempster-Dumpster System. For complete information, contact the manufacturer—Dempster Brothers, Inc.



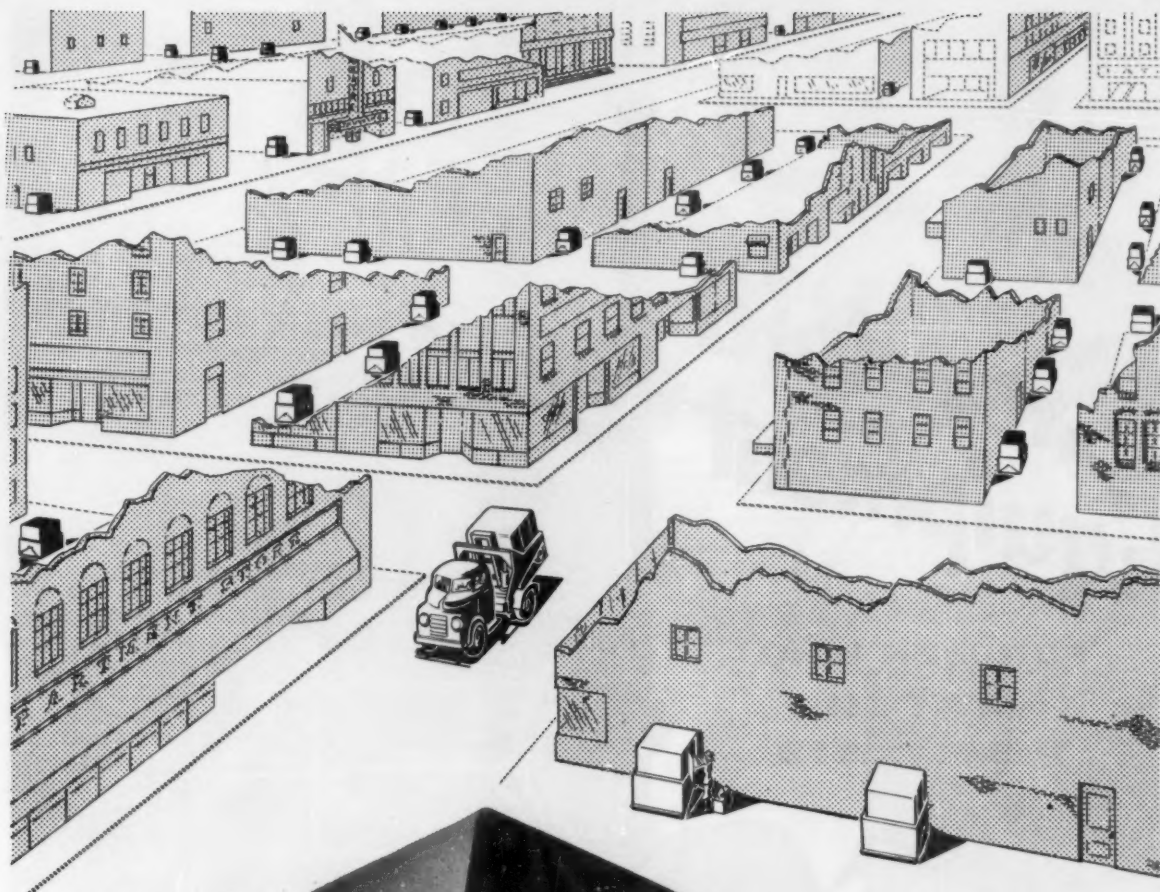
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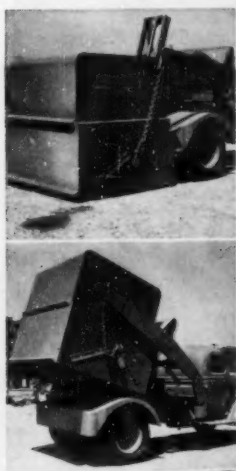
AFTER

There's a Dempster-Dumpster Sanitation Engineer Near You!

6170



We chopped off the buildings in illustration above to enable you to get an idea how this simple system will function in your downtown business district. You will want other containers at schools, hospitals, apartment and suburban areas, etc., depending on your requirements. Average small city has one Dempster-Dumpster serving from 25 to 50 containers. Larger cities of course require larger installations.



By means of hydraulic controls in cab, each container is quickly picked-up, hauled and dumped as shown here. Only one man, the driver, is required.

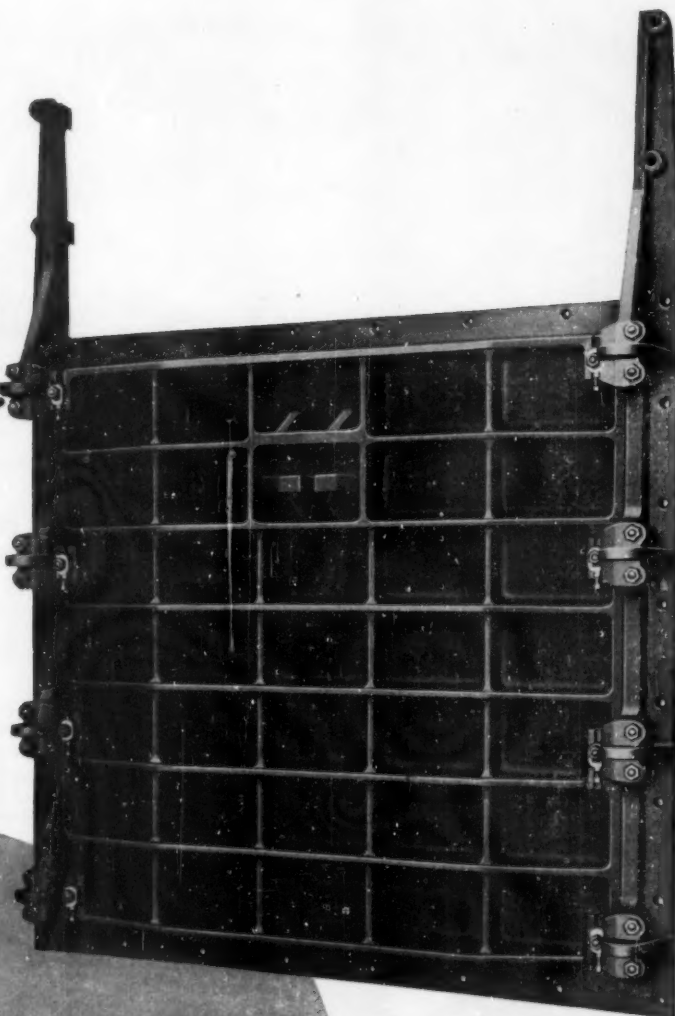


DEMPSTER BROTHERS, 917 Dempster Bldg., Knoxville 17, Tennessee

PUBLIC WORKS for January, 1957

Standard Equipment

**FOR MEN WHO
WATCH
THEIR COSTS**



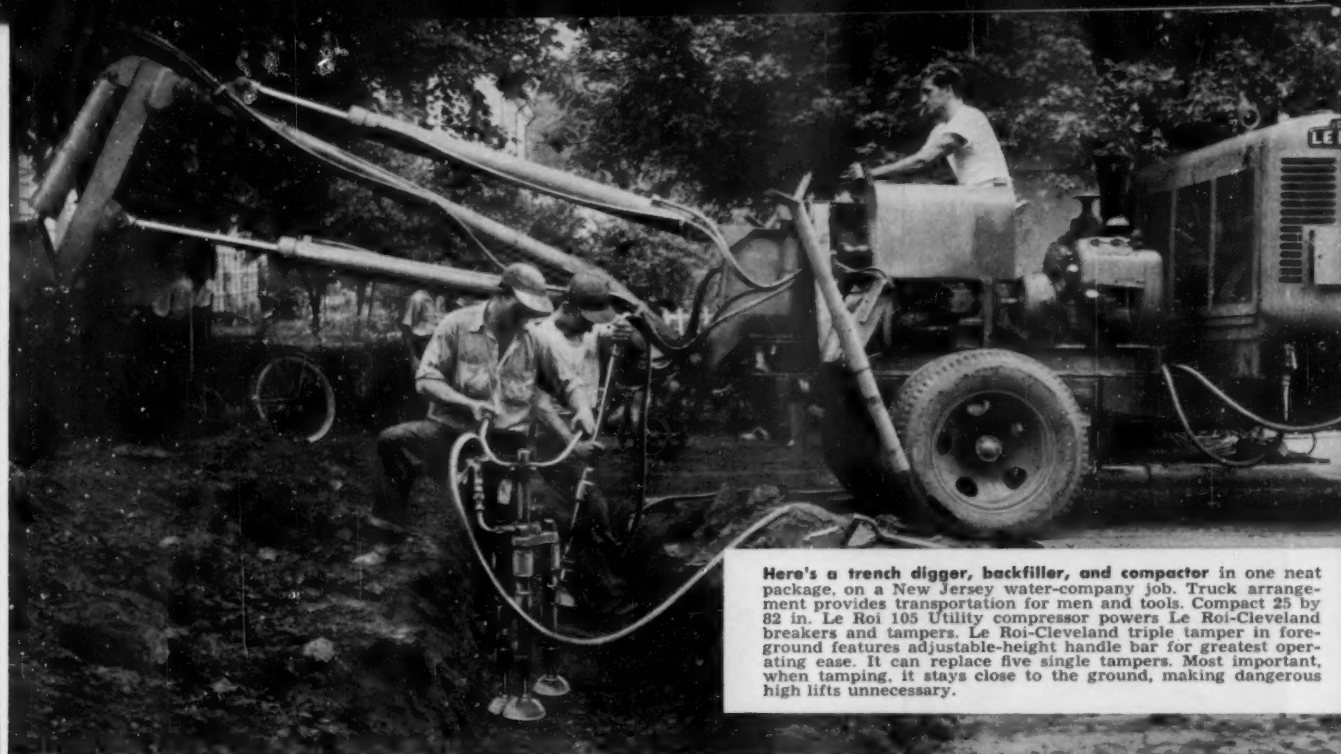
CHAPMAN Standard Sluice Gates

Everything is standardized . . . all component parts. This applies to more than 300 types and sizes of Chapman Standard Sluice Gates. In this way, Chapman can meet *your* specifications at the lowest possible costs. These standardized parts are interchangeable. There's nothing hit or miss about the installation . . . no expensive matchmarking or field alterations. Everything is fitted perfectly at rock bottom cost. Even in use, these gates guard your dollars. The standardized parts are easy to replace . . . easy to fit. It's easy to keep your sluice gates in ideal working condition without expensive repair or service.

What's your requirement? Is it high or low head, seating or unseating pressures, large or small water area? Do you want manual, hydraulic or electric motor operation? Just name it. Chapman has the answer . . . sluice gates to meet your needs, standardized, every one.

Why not write for our Catalog 25-A, now?

**THE
CHAPMAN**
VALVE MANUFACTURING CO.
INDIAN ORCHARD, MASS.



Here's a trench digger, backfiller, and compactor in one neat package, on a New Jersey water-company job. Truck arrangement provides transportation for men and tools. Compact 25 by 82 in. Le Roi 105 Utility compressor powers Le Roi-Cleveland breakers and tampers. Le Roi-Cleveland triple tamper in foreground features adjustable-height handle bar for greatest operating ease. It can replace five single tampers. Most important, when tamping, it stays close to the ground, making dangerous high lifts unnecessary.

Work-Saving Air-Tool Applications

by LE ROI



Gas company employee breaks through tough 12-in. concrete. To speed emergency repair work, this utility chose the maximum shattering impact of a Le Roi-Cleveland 52 paving breaker. Work speed, however, was only one consideration. Low-cost operation was important too. The 52's piston air-cushion reduces internal part wear, makes handling easier.

Highway construction in Mexico is frequently for the birds, or literally could be as this picture indicates. Two operators pictured on this treacherous perch rely on easy-handling Le Roi-Cleveland sinkers, as do 38 others on job. To complicate the fatigue problem, this area around Chilpancingo is often subject to extreme heat. Sealed dust-proof feature is one reason why these tools produce the powerful, constant rotation needed for fast drilling.

On this \$1,600,000 Cleveland sewer job, Le Roi-Cleveland clay diggers set a daily 20-ft. pace. The C-10 clay spade was chosen because a great deal of handling and lifting were required. Operators appreciated a well-balanced tool for this rush job. The spade also is free from bumps, so that operators can get a firm grip and still work close to tunnel walls.



LE ROI Division of Westinghouse Air Brake Co., Milwaukee 1, Wisconsin, manufacturers of Cleveland air tools, Tractair, portable and stationary air compressors, and heavy-duty industrial engines. Write us for information on any of these products.

**FAST, EASY WAY
TO INSTALL PIPE...
AT LOWER COST**



PUSH PIPE UNDERGROUND WITH A GREENLEE HYDRAULIC PUSHER

Here's the simple, cost-cutting way to install underground pipe. Speed your jobs with a GREENLEE Pusher. One-man-operated, portable, simple to operate. No tearing up of pavement... eliminates extensive ditching, tunneling, backfilling, tamping, repaving. Cuts job time to a fraction. GREENLEE Hydraulic Pipe Pusher often pays for itself on first job. Two sizes — model shown above for pushing 3/4" to 4" pipe. Larger unit, below, for pipe over 4", concrete sewer pipe and large drainage ducts. Power pump (as shown above), also available for extra ease and speed of operation.



Write today for descriptive literature. Greenlee Tool Co., 2041 Columbia Avenue, Rockford, Ill., U.S.A.

LEGAL ASPECTS OF PUBLIC WORKS

**MELVIN NORD,
Dr. Eng. Sci., LL. B.**

Discharge of Sewage Contract

In *re Stormer's Estate*, 123 Atl. (2d) 627, a Pennsylvania case decided June 25, 1956, raises the interesting question of whether a contract for the construction of a sewer system is discharged by the death of the contractor, when the contract contained a provision prohibiting its assignment.

Normally, the death of a party to a contract does not discharge the contract; that is to say, his estate remains liable. This is obviously so in the case of money debts owed by the decedent. However, there is an exception to the rule,—namely, that if the contract is of a "personal nature", so that the personal performance of the contracting party is indispensable, it is discharged by death. For example, if an artist contracts to paint a picture and he dies before he can do so, his estate will not be permitted or expected to hire another artist to paint the picture; the contract is discharged.

Normally, the construction of a sewer would not be thought of in the same way as painting a portrait, and therefore a sewer contractor cannot escape his liability by the simple expedient of dying. However, in the present case, a complicating factor appears,—namely, the provision in the contract that it was not assignable. Such a provision normally indicates that the parties are looking for personal performance and not for performance by an assignee of the contract. However, this is not necessarily so, and in the present case, the court held that the provision merely guarded against the possibility that an unqualified person would do the work, instead of Stormer.

According to the court: "The formation of this contract was not induced by any peculiar ability or skill possessed by the decedent. What did induce the contract was



the fact that decedent made the lowest bid. Price, not personal consideration, was the inducement."

Thus, a contract awarded on the basis of public bidding is not a personal contract, even though it contains a non-assignability clause.

Blasted Nuisance

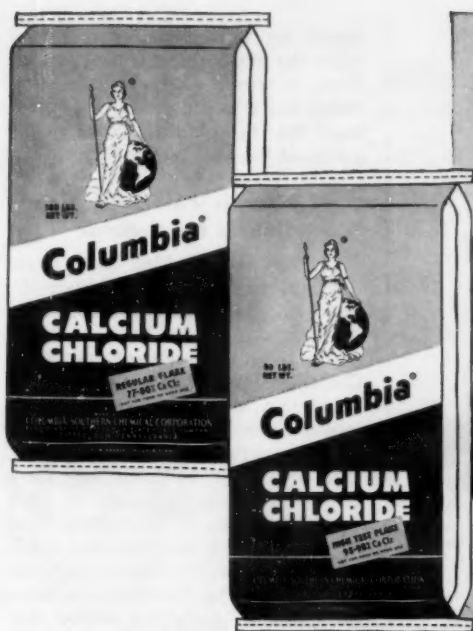
In *Wadleigh v. City of Manchester*, 23 Atl. (2d) 831, a New Hampshire case decided July 6, 1956, a municipality was engaged in installing curbs in a public street. In this connection, it was engaged in blasting operations and, as a result, caused damage to an adjacent house through concussion and vibrations. The owner of the house sued the City, and the Trial Court referred the case to the Supreme Court of New Hampshire to decide several interesting questions of law:

1. Was the City immune from liability on the ground that it was engaged in a governmental act? The court held: No, not if it negligently invaded an adjoining property owner's rights.

2. Is there strict liability on the City, for the damage done, even if there is no negligence on their part? The court held: No. There is no trespass (which would give rise to strict liability), nor is there strict liability in New Hampshire for blasting operations because of their ultra hazardous nature.

3. Is there liability on the City if they were negligent? The court held: Yes.

This case is interesting for several reasons. In the first place, in most states, blasting operations are regarded as ultra hazardous, and strict liability is imposed for the damages caused thereby, even though there is no negligence. And in the second place, the liability of a municipality for invading the rights of a property owner is generally regarded as falling within the doctrine of nuisance, rather than negligence. Under the nuisance doctrine, negligence is not a necessary element of the cause of action; there is strict liability for any "unreasonable" conduct which



Columbia Calcium Chloride is available in Regular Flake 77-80% CaCl_2 content and in High Test Flake 95-98%. One 80 lb. bag of High Test Flake is equal in calcium chloride content to a 100 lb. bag of Regular Flake.

Among the several cost-cutting advantages of using Columbia Calcium Chloride is the fact that a truckload of treated abrasives goes 3 times as far as a truckload of untreated. Treated abrasives anchor firmly; will not blow away.

COLUMBIA CALCIUM CHLORIDE saves you money on ice control

Experience shows that abrasives treated with calcium chloride prove most economical and effective in safeguarding winter traffic on icy or snow-packed roads.

Stockpiles treated with Columbia Calcium Chloride will not freeze. Abrasives stay free and loose; cut loading costs.

Abrasives are easier to handle; *the cost of spreading is reduced.*

Abrasives treated with Columbia Calcium Chloride bite into the icy surface immediately and stay put; *they do not blow away.*

A truckload of treated abrasives stretches 3 times farther than untreated; *a tremendous saving.*

Aside from the big economies that result from using Columbia Calcium Chloride, your traffic benefits from safer driving made possible by skid-proof surfaces. The treated abrasives anchor themselves quickly and firmly in icy surfaces even at the lowest temperatures encountered.

Order your Columbia Calcium Chloride supplies now. Immediate delivery. Available in 100 lb. moisture proof bags Regular Flake; and in 80 lb. moisture proof bags High Test Flake. Both grades in bulk.



**Save money
and safeguard winter traffic
with Columbia Calcium Chloride**



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IN CANADA: Standard Chemical Limited and its Commercial Chemicals Division

**mind if we
knock down
this
scarecrow?**



Stuffed with straw though he is, he sometimes looms like a bogeyman in discussions of municipal water supply. For he represents the idea that diatomite filtration of water supply requires an unusual degree of skill and training on the part of the operator.

Now this is simply not so! The experience of the communities now employing diatomite filtration for their potable water supply is ample evidence that you don't require a highly trained technician to operate a diatomite system. Rather, it tends to show that anyone having intelligence for a responsible municipal job can easily and quickly learn to operate a diatomite filtration system with completely satisfactory results. Granted, where pre-flocculation or other pretreatment of the raw water is used, it helps to have an operator with some technical training, nor do we mean that a diatomite system can be operated by any ten-thumbed fumbler.

Simply and plainly, we say merely this: the operator of a well-designed diatomite filtration system requires no higher degree of skill and technical knowledge than is demanded for the operation of a conventional rapid sand filtration system, which depends so largely on flocculation and chemical treatment. And the experience of the communities now filtering their municipal water supply with Dicalite Filtraids backs us up!

Send for our Bulletin F-552 for more complete information.



dicalite division, great lakes carbon corporation
612 south flower st., los angeles, california

causes an injury, and this is not quite the same thing as negligence. Thus, it seems likely that in most states, there would not be a requirement that the plaintiff prove negligence on the part of the City.

**When is a Sidewalk a
Hole in the Ground?**

On Sept. 3, 1956, Mrs. Edith Kesot was walking along the "sidewalk" between the fenced football field of Dalton High School and the curbing and pavement of West Crawford Street in the City of Dalton, when to her surprise, she fell into a drainage ditch.

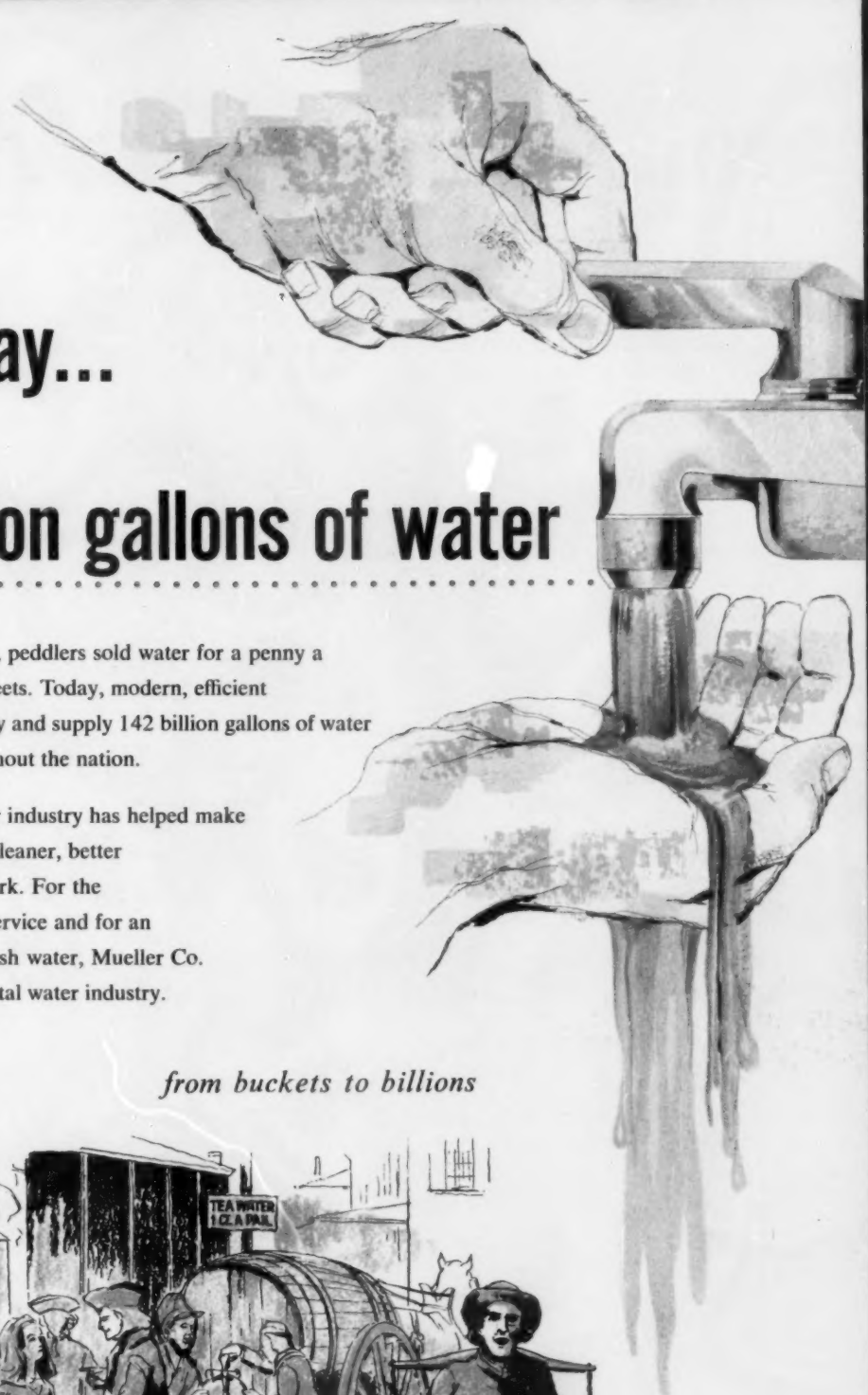
The ensuing lawsuit, *Kesot v. City of Dalton* 94 S.E. (2d) 90, a Georgia case decided July 12, 1956, tells us how it happened and whether or not the City was liable for negligence in maintaining this "sidewalk". The plaintiff's evidence showed that the City owned this land, that it had been used by the public for about nine years as a walkway, that it had never been paved, that the City had constructed five-foot deep storm sewer openings in the center of the walkway and never covered them, and that it had permitted the openings to grow up with grass and weeds so that the openings were not readily visible.

The City's defense was that "that was no sidewalk, that was a hole in the ground!" In other words, the City said that although it owned this strip of land, and that it was in the correct place for a sidewalk, they had never actually maintained it as a sidewalk for the use of pedestrians. Under the rules of law relating to the dedication of land for public purposes, it is necessary to show acceptance by the municipality of this obligation. Mere use by members of the public is not sufficient. Thus, the city owned the land, had the power to use it as a sidewalk, and had acquiesced in members of the public walking over it, but since it had never set it aside and maintained it for this purpose, it was not dedicated to public use as a walkway.

Such are the pitfalls of the law.

**Gasoline Engine Generator
Meets Emergency Conditions**

When a recent power failure cut off electricity in fourteen Ohio counties, an emergency engine generator switched on within seconds to operate Toledo's fire and police signals and radio. Power was off for three hours.



each day...

142 billion gallons of water

.....

A hundred years ago, peddlers sold water for a penny a bucket from wagons in the streets. Today, modern, efficient water systems filter, purify and supply 142 billion gallons of water each day to consumers throughout the nation.

America's outstanding water industry has helped make this country a healthier, cleaner, better nation in which to live and work. For the outstanding progress in service and for an unfailing supply of pure, fresh water, Mueller Co. pays tribute to the vital water industry.

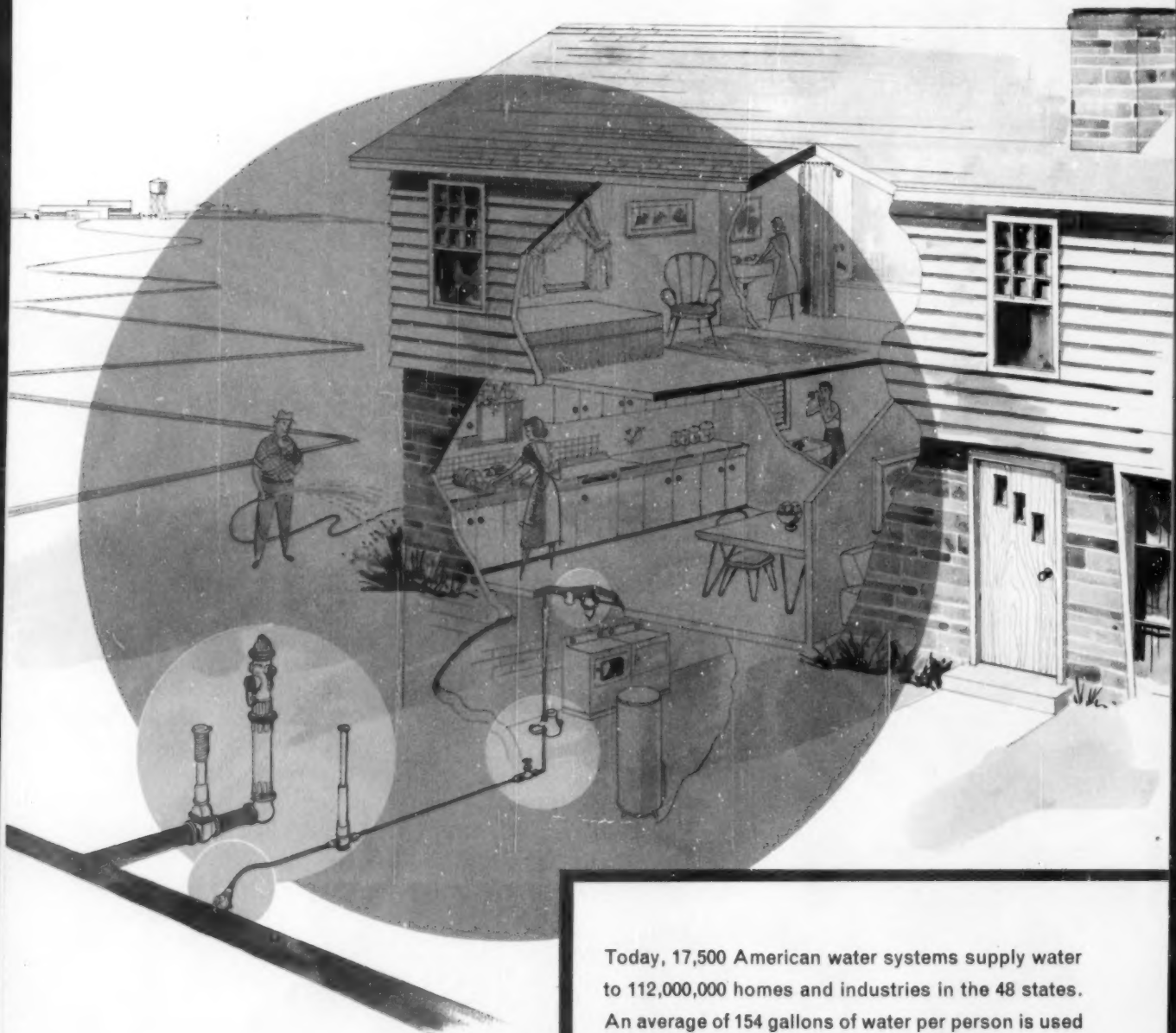


from buckets to billions



Serving 112,000,000

.....



Today, 17,500 American water systems supply water to 112,000,000 homes and industries in the 48 states. An average of 154 gallons of water per person is used each day for a thousand and one purposes in the average American home.



American Homes and Industries

Today's immense water industry is a far cry from the old oaken bucket of a hundred years ago. But a look backward reveals the remarkable growth and development in the field of water treatment and distribution.

The first public water system was in Boston in 1642; and, 150 years later, only 17 systems were in operation in America. In 1829, water for consumption was first treated, at Lynchburg, Virginia, by settling basins that removed silt from raw water. Fifty years elapsed before the first practical method of water treatment by coagulation, sedimentation and filtration was developed to improve the public water supply of Vicksburg, Mississippi.

Thus, the last 75 years have seen the development of the modern water industry and present-day methods of treatment and distribution.

It was previous to this period that Hieronymous Mueller founded Mueller Co. in 1857 at Decatur, Illinois. He was appointed city plumber of Decatur in 1871, charged with plumbing and adding new services to that city's mains. This led to his invention of the original Mueller tapping machine in 1872, improved models of which are now in use throughout the water industry.

Another milestone for water was the use of 42" metal pipe for service at Newark, New Jersey, in 1892. Wooden mains, the mainstay of early water works, were gradually replaced with long-lasting cast-iron pipe. Copper pipe, introduced to the industry in 1924, is now widely used to combat corrosion in water systems.

A major step, that guided the development and growth of the industry, was the formation of the

American Water Works Association in 1881. Professional water works men bonded together in an association where they could share experiences and work out common problems for the benefit of all. For 75 years, this organization, which now numbers 10,000 water works men, has led the growth and progress of the industry. Mueller Co. was one of the first five associate members, joining the organization a week after its formation.

The 656 meager water systems, supplying service to 10,000,000 consumers in 1880, multiplied to the modern network of 17,500 systems supplying 112,000,000 homes and industries today.

Electric power producers and industrial users are the largest consumers of water, each requiring 60 billion gallons daily. Individual consumers are least demanding, requiring only 17 billion gallons each day. Five and one-half billion gallons are consumed in rural areas. This tremendous volume portrays the great growth in the service of our water systems, which, just 70 years ago, provided only 40.9 billion gallons of water daily.

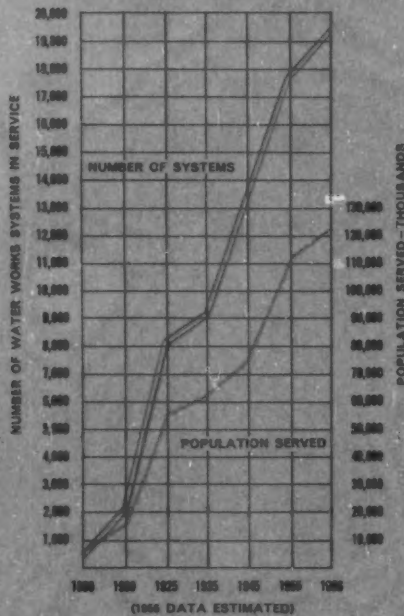
Water works construction has kept pace with the growing water need. During the past quarter century, 4,575 water systems greatly expanded their services and 16,000 new systems have been installed. Construction budgets generally have quadrupled, setting an all-time high in 1956 of about \$272,908,000, a 50 per cent increase over 1955's budget. This huge construction program is brought about by a number of major cities modernizing and enlarging their water distribution systems and by the increasing need for extensions of water service to new suburban areas.



What's ahead for Water?

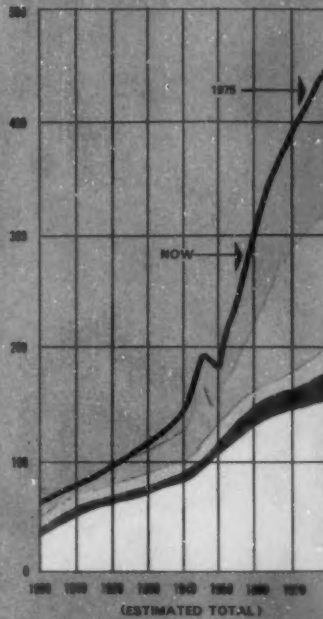
U. S. WATER SYSTEMS

PROGRESS IN CONSTRUCTION



U. S. WATER USE

BILLIONS OF GALLONS—DAILY AVERAGE



Storm
Electric Power
Industrial & Misc.
Farm & Rural
Public Water Supply
Irrigation

Population and industrial growth indicate a probable 73 per cent increase in water usage during the next twenty years.

Daily usage is expected to reach a staggering 284 billion gallons by 1975, twice the present-day consumption! This increase is created by a population forecast of 206 million in 1975, and an anticipated 50 per cent jump in industrial usage.

Extensive expansion of the water industry is expected to continue, with new construction projects and increased budgets enabling the industry to provide a supply of water adequate for future needs.

New techniques may further aid in supplying water requirements. Replenishing ground water re-

sources by artificial means could store water underground with negligible loss through evaporation. Artificial induction of precipitation may help. Research, in processing sea water, could provide a new source of fresh water.

Yet, careful planning and allocation of water resources will be required to supply future development of the Nation. Additional water, from deep well sources, will help increase the supply. Efficient water systems, with modern facilities, and utilizing proper service equipment, will deliver water with minimum loss.

The tremendous progress of the water industry is ample proof of its ability to meet the challenge of the future.

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Factories at: Decatur, Chattanooga, Los Angeles;
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- GLASS BEAD BOND
- EASE OF APPLICATION
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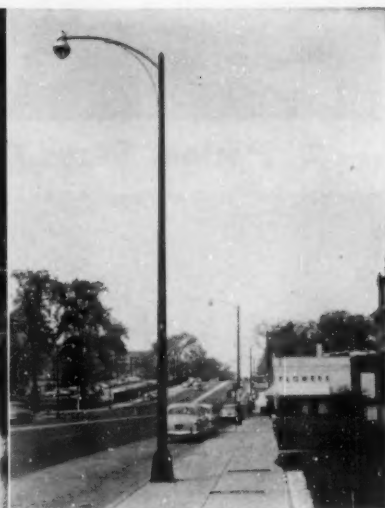
Information on Parlon-based traffic paints is available from your local supplier of quality paints or directly from Hercules.



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PUBLIC WORKS for January, 1957

CR56-B



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Kerrigan Weldforged lighting standards are now found in cities all over the country—in parks and parking centers, on streets, highways and bridges—service stations—sports fields—wherever there is a need for modern lighting. Tall, tapered and handsome, Kerrigan lighting standards are *Weldforged* of high-strength, low-alloy steel, or from aluminum. Maximum strength is combined with beauty of design to meet the highest engineering standards and conform to I.E.S. Street Lighting Codes. Kerrigan standards weather both the elements and the years.

Let us send you detailed descriptive catalog and specifications. Write now for your **FREE** copy.



For better lighted streets, bridges and highways the standard is Kerrigan!



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\$51
BILLION

**Nation's Huge
Highway Program**
**Will Call for Many Miles of
NEW WATER MAINS**

Plans for the vast \$51 billion nation-wide highway building program, which gets under way this year, will involve the re-routing of many municipal thoroughfares. It is also certain to result in still further decentralization of urban centers, since new and improved highways will spur development of outlying areas. These two factors deserve consideration of every city that is studying its future water main requirements.

In this or any other water system planning, long run economy dictates the choice of —

PERMANENT
CAST IRON PIPE

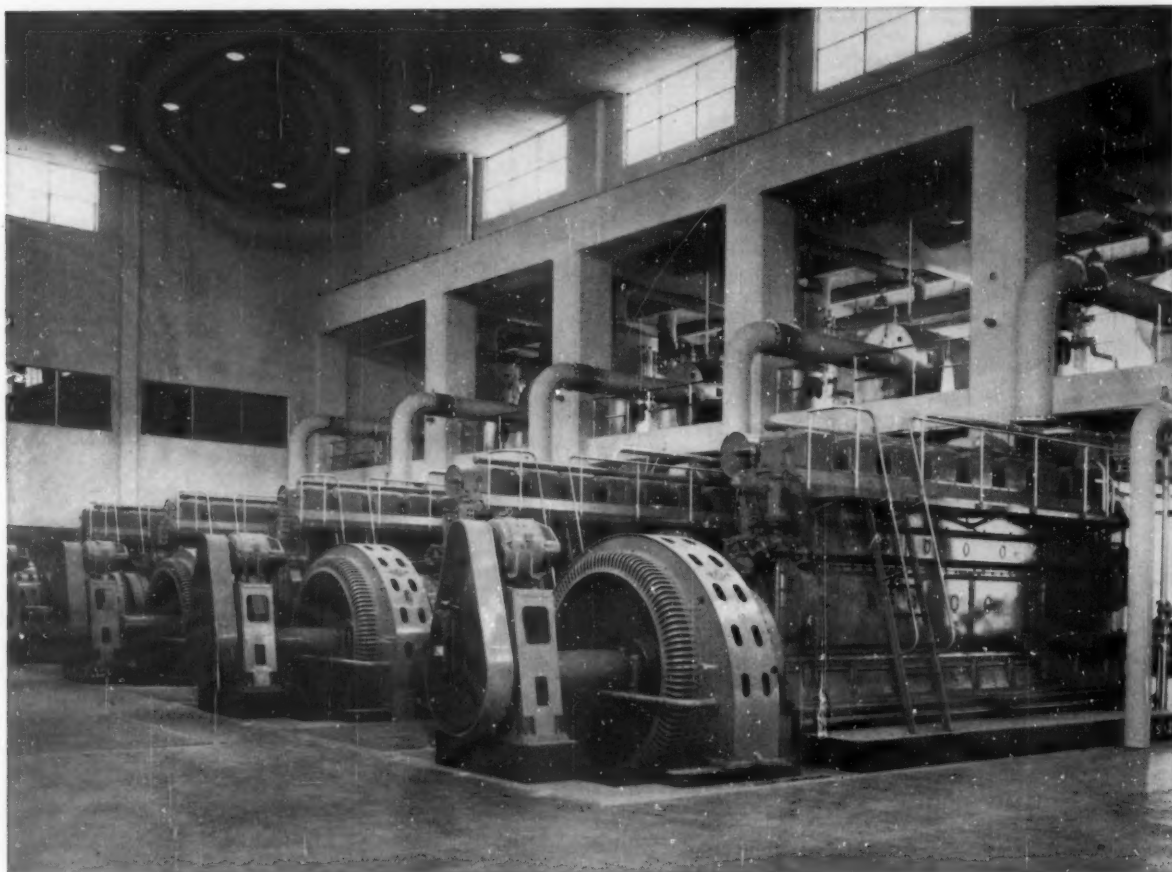
This is the only pipe that has stood the test of time. Because of its century or more of useful life, its high capacity as a carrier and negligible maintenance cost, Cast Iron Pipe has earned its reputation as

"America's No. 1 Tax Saver."

Our Company does not manufacture pipe but has long supplied the nation's leading cast iron pipe manufacturers with quality iron from which pipe is made.

WOODWARD IRON COMPANY
WOODWARD, ALABAMA

"One of the most outstanding operational records in sewage treatment and engine operation" reports Diesel Progress about the Hyperion Activated Sludge Plant of the City of Los Angeles.



10 Worthington engines chalk up 293,899 hours and not one ring, liner, or bearing wore out!

ENGINE	OPERATING HOURS
No. 1	28,928
No. 2	31,163
No. 3	26,926
No. 4	30,422
No. 5	25,648
No. 6	34,472
No. 7	38,367
No. 8	33,785
No. 9	33,753
No. 10*	10,435

*Installed Oct., 1954

In six years of operation, the nine original Worthington engines averaged over 31,000 hours each.

Operating on methane produced in Hyperion's digestion facility, the Worthington engines are turbocharged dual-fuel units rated at 1688 hp each. In six years the ten engines have run 293,899 hours without wearing out a piston ring, cylinder liner, or bearing.

No. 7 Good for 100,000 Hours

Engine No. 7, first on the line, is typical. This engine has 38,367 hours on its original rings. After a routine overhaul, Hyperion engineers predicted a life of 100,000 hours—equivalent to 11 years of continuous operation—per set of rings. They expect double this life for the cylinder liners.

Good Operation

Of course, the finest piece of equipment

would not give such an outstanding record without careful attention to such items as lubrication, clean fuel, temperature control, etc. Good operation is the watchword at Hyperion and annual overhauls, including checking of all operating parts, back up the high quality of the Worthington equipment.

Full Report Available

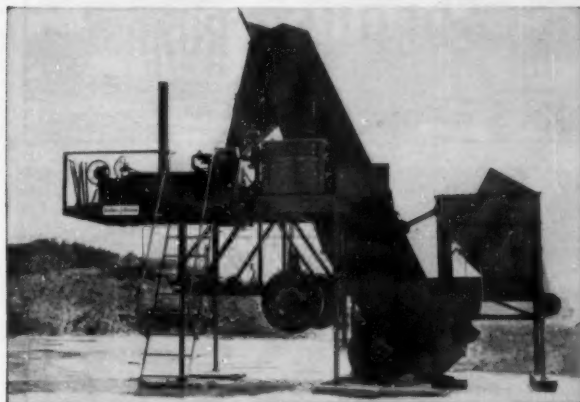
If you would like a reprint of "Hyperion's Six Years of Operation," an interesting article about the plant and its many maintenance innovations, please write to Section W63, Worthington Corporation, Harrison, N. J. Ask for Bulletin RP-928. In Canada: Worthington (Canada) 1955, Ltd., Toronto, Ont.

W.63

WORTHINGTON



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Begin with a mixer, elevator and hopper, and you're set to produce stabilized and cold bituminous mixes at capacities of more than 50 t.p.h. For a low initial investment, the Barber-Greene 840-B gives you big plant features and flexibility.



Later add a dryer to produce hot mixes (to 45 t.p.h.) suitable for nearly every type of paving job. With an aggregate feeder to control cold feed gradation, the complete range of hot mixes can be produced—except specs requiring screening after drying.



For high type mixes, expand operations with a gradation unit to produce mixes (to 45 t.p.h.) to meet any specification. A complete line of dust collectors, cold feeders, mineral feeders is available to meet all of your requirements.

Get big plant features with the low cost Model 840-B. A new, longer twin shaft pugmill, hydraulically operated pugmill discharge hopper, interlocked proportioning, speedy setup, unexcelled portability—all provide more production and profit.

56-5A

Now . . . check into this big money maker. Write for literature



Barber-Greene

AURORA, ILLINOIS, U.S.A.



CONVEYORS...LOADERS...DITCHERS...ASPHALT PAVING EQUIPMENT

PUBLIC WORKS for January, 1957

79

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MUNICIPAL
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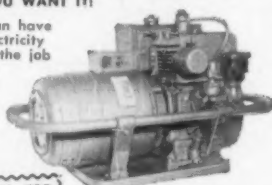
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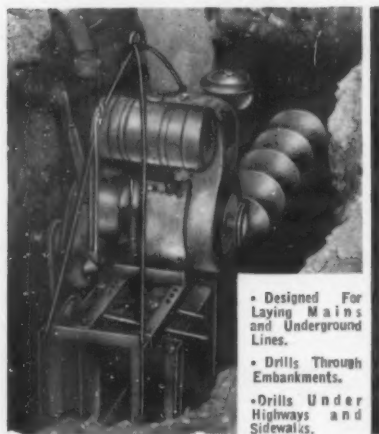


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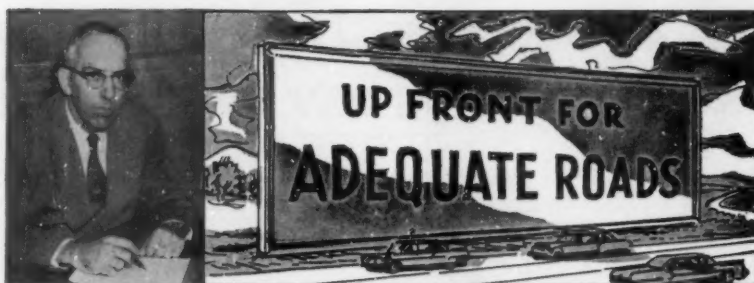
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Highway Consultant

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Pavement—A 2-mile section of con-
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been built by the Pennsylvania De-
partment of Highways on Route 111
north of York. The experimental
section is laid on a grade, sup-
posedly the first of its kind laid on
anything except a level surface.
The section is 12 feet wide and 9
inches thick. The reinforcing con-
sists of $\frac{3}{8}$ -inch steel bar mats laid
at mid-depth of the slab; the design
called for 185 pounds of steel per
100 square feet of pavement, more
than twice the amount normally
used in jointed, reinforced concrete
pavements. Objective of this type of
construction is, of course, to elimi-
nate joints—which require mainte-
nance. The slab does crack, obvi-
ously—but the proponents of this
type of construction claim that only
very narrow cracks develop (at an
estimated spacing of 6 feet, in the
Pennsylvania project) and that the
cracks do not affect the structural
behavior of the slab. If you are
interested, a lot of information
about continuously reinforced pave-
ments is contained in a technical
booklet entitled "Continuously Re-
inforced Concrete Pavements With-
out Joints", which is available on
request from the Rail Steel Bar As-
sociation, 35 South Dearborn Street,
Chicago 3, Illinois.

Traffic Estimation — The Eno
Foundation (Saugatuck, Connecti-
cut) has made another significant
contribution to the field of traffic
engineering through its recent re-
lease of a 250-page book on "High-
way Traffic Estimation". The pub-
lication is co-authored by Robert E.
Schmidt and M. Earl Campbell, who
have made several other significant
contributions in this field. The pur-
pose and coverage of the bulletin
are explained in its preface, as fol-
lows:

"This publication is intended as a
guide for highway planning, design
and traffic engineers, and for others
who must anticipate traffic require-
ments or predict the effects of
changes made in traffic facilities."

It is concerned primarily with
three aspects of traffic estimating:
first, the traffic generating charac-
teristics of major urban land areas;
second, the relative attractiveness
of various types of routes serving
traffic between zones of origin and
destination; third, the growth of
traffic resulting from increases in
population, vehicle ownership, ve-
hicle use, and other factors.

Curing of Concrete — The High-
way Research Board has released
a comprehensive, annotated bibliog-
raphy which covers all U. S. and
Canadian literature, from 1925 to
1955, on the curing of concrete.
It is Bibliography No. 15, Curing
of Concrete.

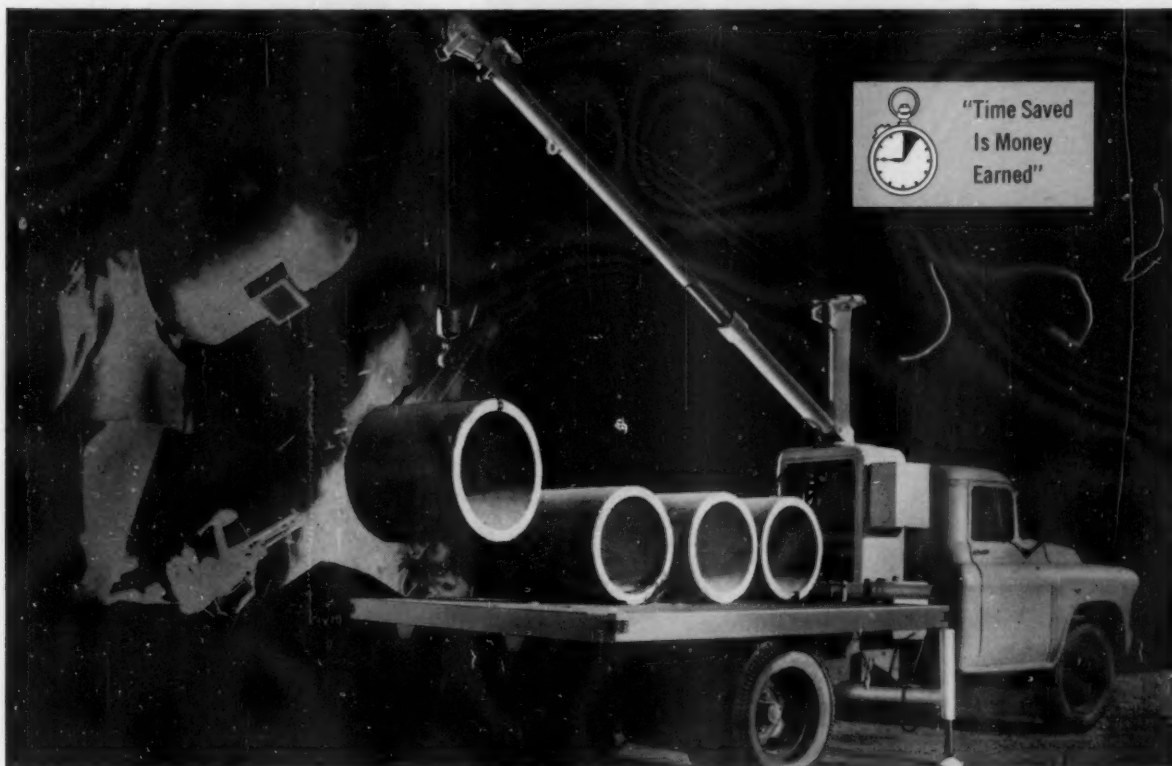
Asleep at the Switch — This writer
must have been asleep at the switch
during the writing of last month's
column, for we forgot to say any-
thing about the appointment of
B. D. Tallamy as the new Federal
Highway Administrator. By the
time you read this, Mr. Tallamy
should have been confirmed by the
Senate and taken over the duties
of this new job. From where we sit,
it seems that the President could
have picked no more capable man
than "Bert" for the job. This man
acts and thinks big, and has a tre-
mendous wealth of experience as a
highway administrator. Congratu-
lations and best wishes.

Something of Value — With apol-
ogies to Robert Ruark, here is
something of value to every street
and highway administrator—the
relatively new series of mimeo-
graphed pamphlets, called "Time-
Saving Methods in Highway Engi-
neering" published by the Highway
Research Board. There are 14
pamphlets, each of which deals with
a separate phase of street and high-

PUBLIC WORKS for January, 1957

LOOK TO DAYBROOK

...For a New Method of Materials Handling by Truck
...THE POWER LOADER!



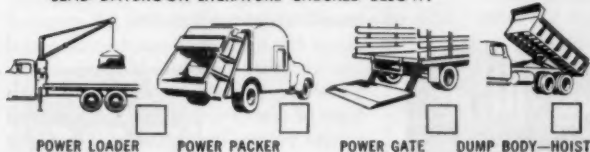
Municipal trucks do more work with savings in manpower when equipped with 100% hydraulically operated Daybrook Speedlift Power Loaders.

FOR EXAMPLE—loading, unloading, and distributing supplies and materials for streets, sewers, and line work—erecting poles or moving

equipment . . . makes a one-man operation anywhere a truck can go.

With the Daybrook Power Loader, trucks become more than a means of transportation . . . really, a new and proven method of bringing increased efficiency to municipal truck operation.

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POWER PACKER ☐

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DUMP BODY—HOIST ☐

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Name _____

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Speedlift®

TRUCK EQUIPMENT

DAYBROOK HYDRAULIC DIVISION

L. A. YOUNG SPRING & WIRE CORPORATION

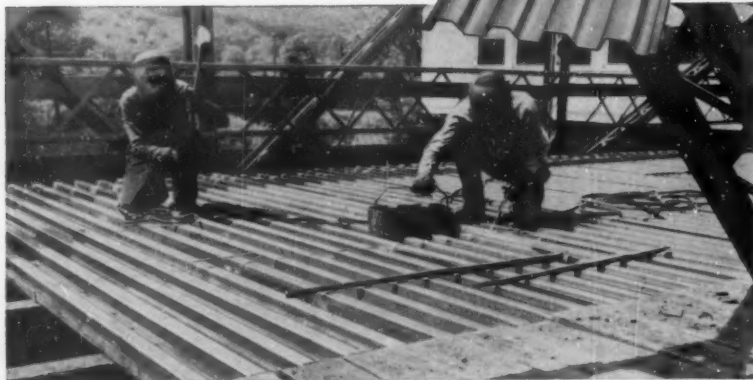
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bridge structures with



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Bridges, overpasses, viaducts and similar type crossings with symptoms of old age such as worn, rattling, wood plank flooring can be rejuvenated at surprisingly low cost with USF Structural-Plate Bridge Flooring. It installs rapidly and efficiently, in least possible "out-of-service" time. It minimizes dead load, stiffens and strengthens structure, and provides uniform support for a smooth bituminous wearing surface. Available shop fabricated to your requirements or in standard lengths for emergency stocks.



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Highway Guard Rail • Bridge Flooring • Steel Forms for Concrete Bridge
Floors • Corrugated Metal Pipe • Sectional Plate Pipe and Pipe Arches

way engineering—titles are Administration; Planning (Statistics, Economic Analysis, etc.); Location; Road Design; Bridge Design; Construction; Contracts, Estimates, Specifications; Maintenance and Equipment; Traffic Engineering (Management of Traffic Operations, etc.); Right-of-way; Cost Accounting and Control; and Summary. Each installment is chock-full of time-saving ideas, methods, and sources—the material contained in the pamphlets came from a questionnaire submitted to all of the state highway departments. The pamphlets can be purchased individually, at varying prices, or the whole group purchased (cost—\$4.50) from the Highway Research Board, 2101 Constitution Ave., Washington, D. C.

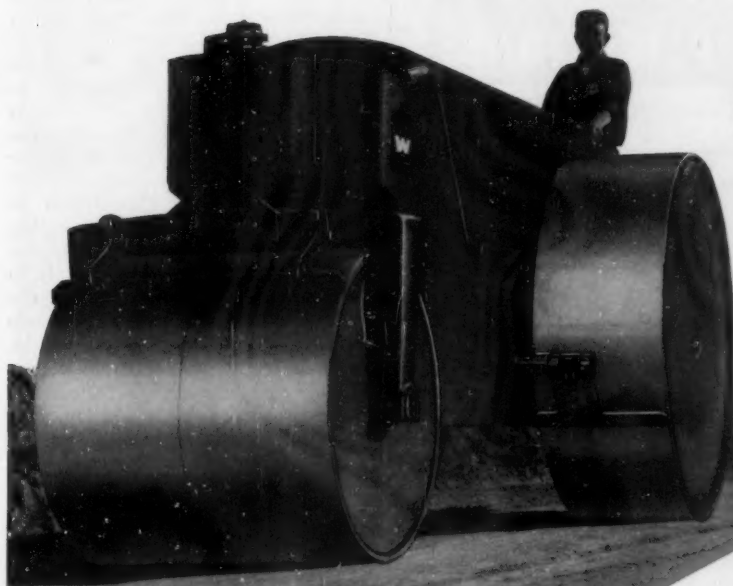
Freeways — A real nice selling piece on "What Freeways Mean to Your City" has been released by the Automotive Safety Foundation, 200 Ring Building, Washington 6, D. C. An outsize, 50-page book, the manuscript provides factual answers to such questions as these: How Safe Are Freeways? Do Freeways Save Travel Time? Do Freeways Pay for Themselves? Do Freeways Hurt Business on Adjacent Streets? and several more. The booklet provides good ammunition for selling freeways to the city council, the voters, or any other interested persons or groups. Data cited are factual and authoritative; an impressive case is built up for the use of this type of controlled access facility.

Crushed Stone Base Courses — Joseph E. Gray of the National Crushed Stone Association has authored an interesting and informative account of crushed stone base courses in the June-September issue of the *Crushed Stone Journal*. Mr. Gray describes and compares the two principal types of crushed stone base courses in use in flexible pavement construction today—dry-bound or waterbound macadam and graded aggregate. As Mr. Gray points out, the two types—properly constructed—are very competitive in load-bearing characteristics and performance. Choice is generally based upon availability of crushed stone for macadam construction and comparative costs. Modern construction practices relative to each type of construction are summarized in the paper. Incidentally, Mr. Gray has recently been appointed Engineering Director of the NCSA, replacing the irreplaceable A. T. Goldbeck, who has retired.

"all new MODERN design"

torque converter

2-speed transmission



General Purpose • Finishing or Variable Weight

Huber-Warco's newly-designed 3-wheel roller is a powerful, rugged machine built for economy, performance and durability. Greater roller efficiency is achieved by the use of a torque converter, tail-shaft governor and 2-speed transmission.

Other important features include: three-point "live" suspension of the sub-frame to cushion shocks, anti-friction bearings throughout, completely adjustable guide roll assembly, dual braking systems, and many other important bonus features.

Huber-Warco 3-wheel roller can be supplied with variable weight rolls, or with cast iron rolls, in various sizes, for general purpose or finishing work.

See your Huber-Warco distributor for complete details. The Huber-Warco 3-wheel roller is the most modern, dependable roller you can buy.



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1957 ROAD SHOW—BOOTH 714

On display—Motor Graders • Road Rollers • Maintainers

HUBER-WARCO CO., MARION, OHIO

JACKSON VIBRATORY COMPACTORS



BLACKTOP PAVEMENT PATCHING

The manually guided Jackson Vibratory Compactor delivers up to 4200 2-ton blows per minute, is self-propelling and will compact bituminous mixes in 5" layers close to maximum density at the rate of 1800 sq. ft. per hour. Operated from a power plant mounted on an auto trailer with device for quickly picking up and lowering the compactor, this is positively the most advantageous outfit ever offered for patching blacktop pavement, paving drives, walks and similar applications.

It's equally efficient in compacting granular soils in bridge approaches, water, sewer and gas mains and laterals, sub-bases of pavement widening projects, sub-bases of concrete floors, in trenches (interchangeable bases from 12" to 26" available), and dozens of similar applications. 100% of specified density is readily achieved in 10" layers. The Power Plant is fully capable of operating two of these compactors simultaneously and in many instances labor costs can be cut in two by use of the twin-unit shown at right.

For consolidating base courses of rock, slag, gravel and sand in waterbound and penetration macadam construction the Jackson Multiple Compactor is indeed outstanding. It is used on practically all of the important paving jobs in the nation. By all means write for the complete facts.



**TWIN UNIT ▲
DOUBLES PRODUCTION**

TERRIFIC TIME SAVERS ON ALL THESE APPLICATIONS:

BACKFILL TAMPING



CAMPACTING IN TRENCHES, ETC.



MACADAM CONSTRUCTION



**JACKSON
VIBRATORS, INC.**

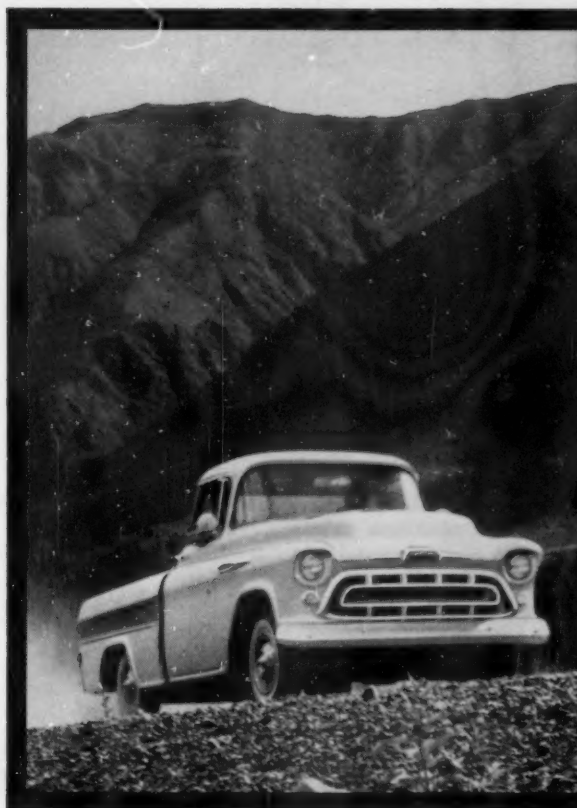
LUDINGTON, MICH.

Travel Notes — We looked over some more highways during the last month or so. Saw the eastern end of the Kansas Turnpike from the air. Looked very nice, with a number of sections in which it appeared that the two dual-lane roadways were widely separated, but carrying very little traffic. Also had a chance to look at some of the highway improvements in Denver and northern Colorado. Rode the Denver-Boulder Turnpike, which was almost deserted on a Sunday afternoon. It has been repaired and is in good shape—Also travelled from the north end of the Valley Highway to the center of Denver—as far as it has been finished. Completion of this expressway and connecting links in 1958 will provide easy access into downtown Denver from both the north and south, and a direct connection from Colorado Springs to northern resort areas. As usual, highways outside of the Denver metropolitan area are in pretty poor shape, but that may be only natural, since the state has very little money for highway purposes.

From Here and There — A major step in CAA's program for improvement of the country's air traffic control system was taken late in November when the CAA announced that it had placed an order for 23 long-range radars. Don't forget the two big meetings this month—the Highway Research Board, in Washington, January 7-11; and the ARBA Convention and Road Show in Chicago, Jan. 28-Feb. 2. Grading work on the AASHO Road Test sections—located near Ottawa, Illinois—has been completed; construction is scheduled to be finished and testing begun by the fall of this year. The Calcium Chloride Institute in October conducted six one-day road and street maintenance schools in as many cities in Michigan. Wilbur Smith Associates have been engaged to prepare a preliminary report on a projected 17-mile access expressway system for Tampa, Florida. Florida's Sunshine State Parkway is scheduled to open this month, just in time for the after-Christmas tourist rush.

• • • Sidewalks Cost 44 Cents Per Sq. Ft.

A contract was let recently by St. Paul, Minn., for sidewalk construction. The price per sq. ft. for the 4-in. walk was 44 cents, compared to 43½ and 45 cents on recent bids.



THESE '57 CHEVIES TURNED THE TOUGH ALCAN HIGHWAY INTO A TURNPIKE!

They took the "teeth" out of North America's toughest truck run in an amazing display of stamina and dependability! The Chevrolet Alcan test called for great truck components . . . and here they are, the same modern features you'll get in your '57 Chevy!

Modern high-compression 6's—a time-proved Chevrolet truck Thriftmaster 6 made the tortuous Alcan Highway test look easy . . . registered a high 18.17 miles per gallon!

Short-stroke V8 power—with the shortest stroke of any truck V8's, new Chevy engines stand first in their field for efficient load-pulling! Their great performance in Alaska proved it.

Safe, sure brakes now Alcan proved—in light- and medium-duty models, Hydrovac power brakes* supplied up to 85% of the braking effort!

Unit-design cab and body construction—Chevrolet

truck cabs and bodies remained tight and solid on Alcan bumps, showed that they're built to last! *Rugged Synchro-Mesh manual transmissions*—they displayed never-say-die durability . . . came through with smooth, flexible, trouble-free performance!

*Easy-going Hydra-Matic transmission**—it reduced driver's work immeasurably and it saved wear on drive-line parts, too!

Sturdy frames and long-leaf springs—these brawny chassis components proved they can take it when the going is roughest . . . took the Alcan's worst with strength to spare!

These Alcan-proved Task-Force 57 features and others like them (such as extra-heavy rear axles, easy-rolling Ball-Gear steering, and new, improved tubeless tires) are ready to tame your tough truck runs too! Boost your hauling profits by seeing your Chevrolet dealer soon! . . . Chevrolet Division of General Motors, Detroit 2, Michigan.

*Optional at extra cost.

1957 CHEVROLET TASK-FORCE TRUCKS

PROVED ON THE ALCAN HIGHWAY . . . CHAMPS OF EVERY WEIGHT CLASS!



PUBLIC WORKS for January, 1957

800

more tons per day
of incineration for
BALTIMORE, MD.



charging floor



stoking floor

PITTSBURGH • DES MOINES *Incineration Plants*

Matching Baltimore's civic growth, this great new 800-ton Pittsburgh-Des Moines Incineration Plant is the city's second large PDM unit. Employing mechanical stoking for its four furnaces, the new plant has operated steadily beyond rated capacity from the first day in service. *Send for our latest Modern Refuse Incineration Brochure.*



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TAKES OBSTRUCTIONS
IN STRIDE



HAS GOOD OPERATOR
VISIBILITY



OUTRIGGERS LEVEL
UNIT



FORMED PLATE
BOOM AND STICK



SHOVEL BUCKETS
FOR EVERY PURPOSE



DUMPS AT 11 FEET

NEED A WORK-HUNGRY, EASILY OPERATED
DIGGER? ... SHOVEL? ... CRANE?

HOPTO
is **YOUR**
LOW-COST ANSWER!



completely
hydraulic

Here's the fast cycling, 200° swing, *completely hydraulic* digger-shovel-crane that reaches out for work! HOPTO has a 16½' reach at ground level *beyond* the boom mounting; digs more than 11' deep and dumps at 9½' with backhoe and 11' with shovel bucket!! It's the easy-to-operate unit your handy man will handle like a veteran in half a day!

HOPTO mounts on *any* ton-and-a-half or larger truck. Hydraulic outriggers level unit and take load from truck chassis and springing mechanism! Feather-touch controls in the full visibility cab actuate every movement of unit and outriggers. No belts, pulleys, cables or sheaves on a HOPTO! It's *completely hydraulic*!

The 1500 PSI hydraulic system has overload relief valves, double wire braided hoses, 5" inside diameter hydraulic cylinders with 2¾" chrome plated piston rods, and a large oil reservoir for most efficient operation! Self aligning bearings and hardened alloyed steel pins... formed steel plate boom, stick, and sub-frame... direct mounting of pump on power unit... crowd cylinder *above* boom... these are but a few of the many *long-life, low-maintenance* features of the quarter-yard, work hungry HOPTO.

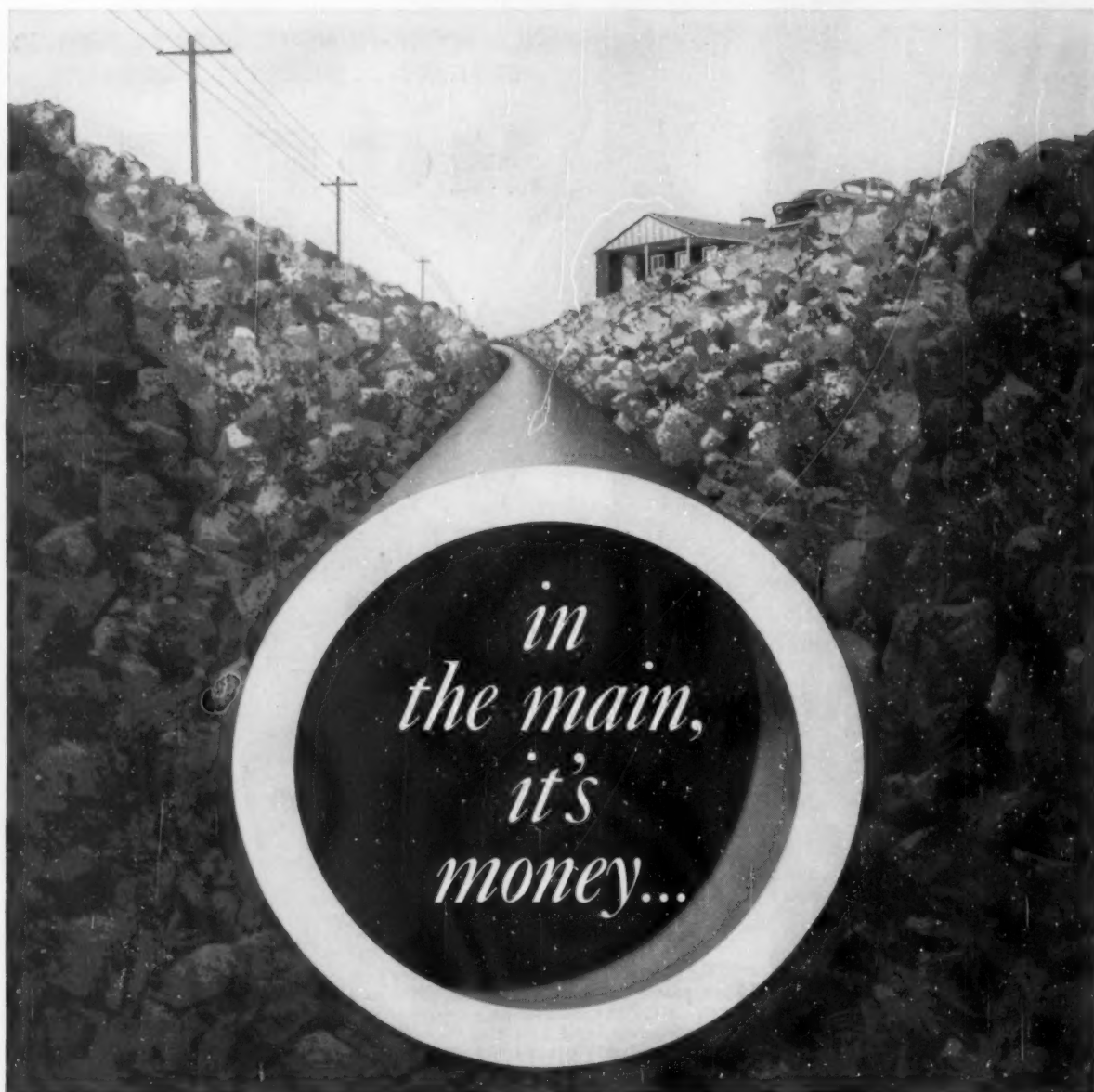
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MANUFACTURERS OF A COMPLETE LINE OF 1/4 YARD AND 3/4 YARD HYDRAULIC DIGGER-SHOVEL-CRANE

BADGER MACHINE COMPANY

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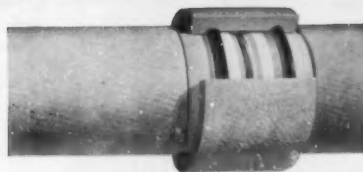


your tax money!

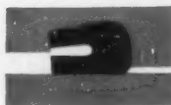
Non-tuberculating, non-corroding, non-electrolytic . . . these features of non-metallic K&M Asbestos-Cement Pressure Pipe mean low, stable pumping pressures and NO MAINTENANCE . . . Big tax savings for American communities!

But there are further tax savings in initial cost and installation with K&M Asbestos-Cement Pipe. It's light in weight, easily and inexpensively transported and handled. And K&M's EXCLUSIVE "Fluid-Tite" Coupling allows quick assembly under any weather conditions—even with unskilled labor.

Write today for complete information.



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Compressible rubber rings allow easy pipe insertion.



Pressure expands rings. Higher pressure—tighter seal.

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LIGHT UP AMERICA...
IT'S DARKER THAN YOU THINK!

Someone will get credit for lighting this street. Who will it be?

Pretty soon something's bound to happen on a dark street like this, and when it does, someone will spearhead a drive for good public lighting. He'll get what he's after, too, because who casts a vote for darkness on his community's streets?

And when the lights come on, business picks up, accident rates drop, there's less crime. Streets *look* safe and prosperous—and they *are*.

The cost? Good street lighting is the least expensive capital improvement you could sponsor.

"Out of Darkness" a new, dramatic film story of how one community met its street-lighting problems, is now available to civic groups, community service organizations, etc. This 16-mm, sound, black-and-white movie runs 26 minutes. Borrow a print of "Out of Darkness" from your nearest G-E Apparatus Sales Office.

Section Y455-10

**Outdoor Lighting Department,
General Electric Company, Schenectady 5, N. Y.**

Please send me a free copy of the 16-page bulletin, "Residential Street Lighting," GEA-6316.

Name

Street

City and State

Progress Is Our Most Important Product

GENERAL  ELECTRIC

Available ONLY on a
PAYLOADER®



DROTT 4-in-1 buckets

The Frank G. Hough Co. is pleased to announce that another valuable attachment has been added to those available exclusively for "PAYLOADER" tractor-shovels. This is the Drott 4-in-1 bucket which, coupled with the power and mobility of the current line of 4-wheel-drive "PAYLOADER" tractor-shovels, gives them greater performance on many jobs, and the ability to handle many operations that usually require special machines.

More than ever before, you get more tractor-shovel when you buy a "PAYLOADER", because you get more tractor-shovel performance and more versatility.

They have power-transfer differentials—an exclusive "PAYLOADER" feature that maintains effective traction on mud, gravel, ice and snow. They have no-stop power-shift transmissions and torque converters . . . planetary final drives . . . power steering and 4 wheel power brakes. They have the exclusive bucket motion with 40° tip-back and powerful pry-out action that enables them to dig more, carry more and deliver more . . . to outperform any comparable tractor-shovels.

Your "PAYLOADER" Distributor is anxious to demonstrate what these "PAYLOADER" tractor-shovels and Drott 4-in-one buckets can do for you.



SHOVEL

The four-in-one bucket can always be used as a regular tractor-shovel bucket to dig, carry and dump in the regular manner.



CLAMSHELL

Use the powerful clamshell action to clean up small piles, to pick up without tractor travel, to grasp and handle stumps, pipe and timbers fast.



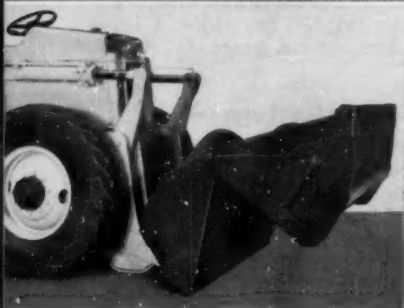
SCRAPER

With slight clam lip opening you have a carry-all scraper that heap-loads itself, carries and spreads thin layers or dumps completely. Strips sod and grades with real accuracy.



BULLDOZER

Open the clam lip full, and you have a sturdy bulldozer with hydraulic fingertip blade-pitch control to regulate dozing depth and to discharge sticky material.



help you handle more jobs

OTHER USEFUL ATTACHMENTS

Hydraulic Back-hoes

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Winches

Log and Lumber Grapples

Land-clearing Rakes

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Special Buckets

Pick-up Street Sweepers

Rotary Snow Plows

"V" and Blade Plows

The knowledge and experience gained in 35 years, building thousands of tractor-shovels — more than all others combined — is your assurance of superior design, engineering and value when you invest in a "PAYLOADER" tractor-shovel.



PAYLOADER®

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THE FRANK G. HOUGH CO. LIBERTYVILLE, ILL.
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THE FRANK G. HOUGH CO.
761 Sunnyside Ave., Libertyville, Ill.

Send full data on 4-wheel-drive "PAYLOADER" models with Drott 4-in-1 Buckets as checked:

☐ model HO 2 1/4 yd. ☐ model HH 1 1/2 yd.
☐ model HU 1 yd.

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Company _____

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14



Adams Filters installed at the new Delaware pool in the Town of Tonawanda, N. Y., give the water extra polish and beauty . . . a special invitation to enjoy the pleasures of this beautiful pool.

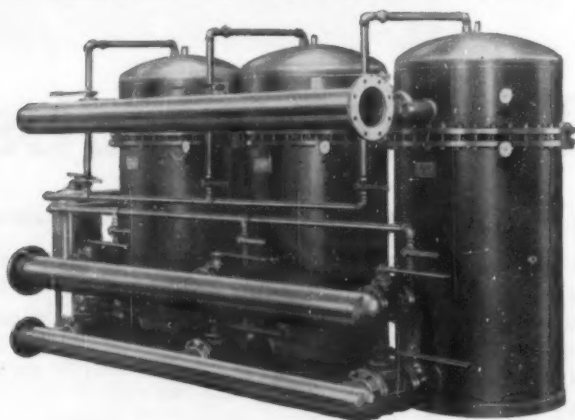
It's easy to keep your pool water Crystal Clear at Lower Costs

Hundreds of swimming pools across the nation have found that Adams filtration packages are the right answer. That's because of the advanced engineering design . . . diatomite filtration . . . permanent Poro-Stone elements . . . compact installation . . . simple operation featuring a new backwash technique.

We have a wide range of filters and delivery is prompt. You'll find the price of crystal clear water for your pool is amazingly low, so write for complete information, today.

ADAMS SPF...

TODAY'S FINEST SWIMMING POOL FILTER

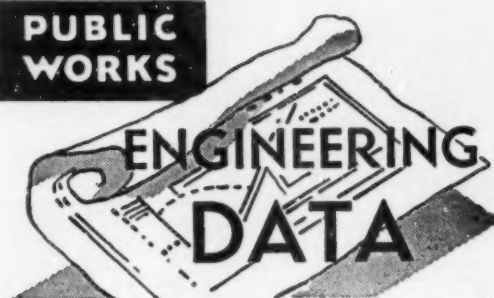


Adams SPF filters are ideal for community pools like that illustrated above. This triple SPF 169 can handle pools up to 730,000 gallons capacity.

R. P. ADAMS CO., Inc.

228 East Park Drive, Buffalo 17, N. Y.

PUBLIC WORKS



Man-Hours Required for Certain Types of Work

One of the important factors in performing most types of work is the man-hours required. San Diego, Calif., Department of Public Works has kept a record of the time required to do certain types of work. The following show the man-hours required for (a) 1954-55 and (b) 1955-56: Rubbish collection per ton (a) 2.21 hrs., (b) 2.13 hrs. Garbage collection per ton: (a) 5.30 hrs., (b) 5.17 hrs. Machine cleaning of sewer mains per 100 lin. ft.: (a) 0.62 hr., (b) 0.50 hr. Constructing street connections each: (a) 50.36 hrs., (b) 50.05 hrs. Manhole repairs each: (a) 5.40 hrs., (b) 3.89 hrs. Blading and sprinkling dirt streets per blade mile: (a) 15.47 hrs., (b) 14.85 hrs. Major surface patching per ton: (a) 2.32 hrs., (b) 1.46 hrs. Minor surface patching per ton: (a) 6.12 hrs., (b) 6.67 hrs. Painting guard rails per lin. ft.: (a) 0.06 hr., (b) 0.06 hr. Flushcoating per 100 sq. yds.: (a) 0.30 hr., (b) 0.29 hr. Installing new parking meters, each: (a) 0.17 hr., (b) 0.16 hr. Lamping incandescent lights, each: (a) 0.24 hr., (b) 0.21 hr. Service and repair of dual meters, each: (a) 0.44 hr., (b) 0.40 hr.

Utilization of Engineering Personnel

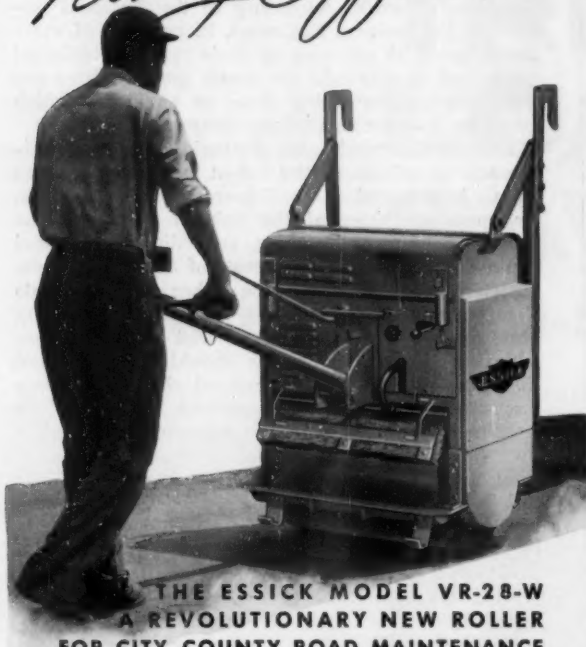
A panel discussion on this subject was held at a recent meeting of the So. Cal. Chapter, APWA. The discussion panel included: Fred S. Lohman, Chief Deputy City Engineer of Los Angeles; Mrs. Thelma Pollard, Assistant Engineer, Pacific Telephone Co.; Fritz Zapf, City Engineer of Monrovia; and William R. White, Consultant with Booz, Allen and Hamilton. Frank E. Randall of the Pacific Telephone Co. was Moderator.

The discussion was confined to three areas: The engineer, a definition of his duties, building up his status; breaking the job down so as to use subprofessional employees to the fullest extent; standardization and routinization of engineering work. While all are aware of the problem of getting engineers, this discussion went to the side of using what is available to the greatest degree, particularly engineering talent, which is in so much demand today.

It was the consensus of the group that the engineer wants to think of himself as a part of the management team and wants management to reciprocate by treating him as a part of the team, to let him in on the signals and let him play in the game. He should be included in staff meetings to determine objectives of the organization and to schedule the priority of jobs. He should have contact with the top management and not be a mere pigeon hole. He should present his projects, at least once in a while, to the top approving authority. He should have the use of back-up employees at the inception of design, who would collect data, prepare rough drawings for

CITY COUNTY STATE

Paving Officials



**THE ESSICK MODEL VR-28-W
A REVOLUTIONARY NEW ROLLER
FOR CITY, COUNTY ROAD MAINTENANCE**

Here's a vibrating roller that not only ends compaction problems, but cuts high costs to the bare bone. Producing better compaction on asphaltic materials than a five ton dead weight roller, the 800 pound Essick Model VR-28-W is a hand-guided, self-propelled marvel equipped with carrying hangers that fit any dump truck. However you look at this great roller it adds up to **first**... in mobility, portability, and just plain ability. There's **nothing** like an Essick, a demonstration shows **why**.



**VR-28-W
WITH CARRYING HANGERS**

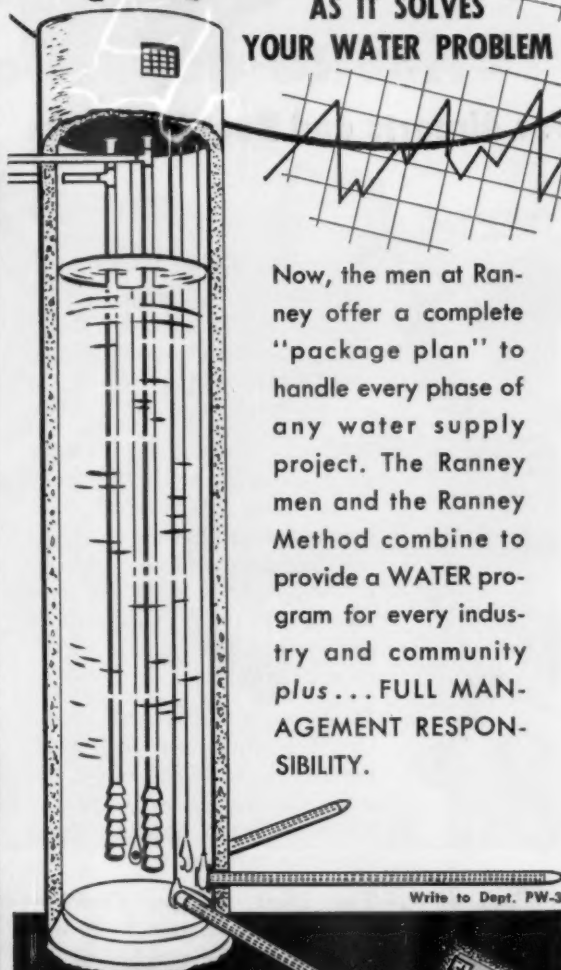


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**AS IT SOLVES
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Now, the men at Ranney offer a complete "package plan" to handle every phase of any water supply project. The Ranney men and the Ranney Method combine to provide a **WATER** program for every industry and community **plus... FULL MANAGEMENT RESPONSIBILITY.**

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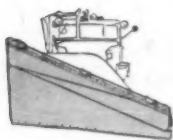
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informative
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Write Today!

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There is only one Roll-Over
... and it's made by FRINK



For Airports and Dual Highways



The Frink Taper Blade Roll-Over Sno-Plow combines the advantages of the reversible blade type with higher speed, deeper snow handling qualities of the one-way plow.



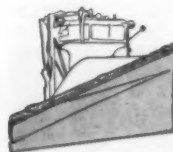
This plow throws and spreads the snow, yet can be hydraulically rotated from left hand to right hand plowing position in 15 seconds, enabling the operator to throw *all* the snow in the most favorable direction as dictated by the wind or the location of the disposal area.



Deadheading is eliminated, therefore, less equipment is needed. Parking is easier, because the truck can be parked with the Roll-Over in the upright position within its own width.



The Frink V-Type, One-Way Type, and Reversible Type Sno-Plows can all be attached to the Roll-Over Lifting Device Assembly.



Clayton, 1000 Islands, New York

Made in Canada by

Frink Sno-Plows of Canada, Ltd., Toronto, Ontario

him and when the design is completed in the rough, subprofessional employees or clerks should be available to polish up the completed details for presentation to top level management. Supporting personnel could do much of what used to be thought of as "engineer's" work. According to the National Society of Professional Engineers, 85 per cent of engineers spend 75 per cent of their time on technical work, and in this field the group thought there are many things now being done by engineers which could be done by subordinate personnel.

There was considerable discussion and some differences of opinion on the extent to which engineers should be relieved of detail operations. For instance, two panelists were of the opinion that with the proper averages and tables, subordinate personnel could do the estimating of costs of almost any construction project, while the other two panelists thought only engineers were capable of estimating costs. It was generally agreed that wherever possible, rotational assignments should be made and that young engineering personnel should be given important engineering assignments early in their training. All agreed that it is necessary to visualize the total work to be accomplished as made up of small units of work and that the study of flow charts to break down for analysis each step of a job is one of the best aids to determine what kind of person is required for each step. An attempt should always be made when different units of work are to be accomplished to match processes with definitely established units of activities or personnel functions.

All the panelists felt that much could be done in engineering offices toward routinization and standardization of the work process and it was their conclusion that we should think of the job process in relation to decision-making. What can be done to cut down the number of decisions made by technical staff people? Could these decisions be turned over to routine? What does it cost to have the highest trained group make similar calculations over and over again? It should be the work of engineers constantly to develop standards by which the work can be done, to take away from the technical staff much of the petty decision-making. The most significant application of routines and systems have been for the purpose of facilitating the work of management itself by relieving it of much of the task of detail supervision and minor decision-making.

New York-New Jersey Air Pollution Study Initiated

An interstate study of smoke and air pollution in the United States has been initiated in New York and New Jersey with the adoption of a budget of \$60,000 and a general plan for the study by the Interstate Sanitary Commission. Frederick S. Mallette of Riverside, Connecticut, is to be technical consultant for the study.

The Interstate Sanitation Commission was established to investigate water pollution problems in areas of New Jersey, New York and Connecticut adjacent to New York City. In its new capacity, ISC is empowered "to make a comprehensive study of smoke and air pollution in the areas of New York and New Jersey specified . . . and the problems caused thereby. The study shall include a survey of the sources and extent of such pollution, property damage caused thereby, its effect upon public health and comfort, and relevant meteorological, climatological, and topographical factors."

DIG TRENCH LOAD SAVE

...with one fast-to-the-job Oliver!



Think of it! A *one-man* machine to handle all kinds of excavating and trenching jobs. That's exactly how cities across the country are cutting costs with the Oliver Super 88 Hydro-Trencher.

This advanced compact machine travels with rubber-tired ease over busy streets and work all those tight, awkward places. Yet, there is nothing small or limited about the variety of tough jobs it handles. There's a full 49.81 drawbar horsepower with six forward speeds.

With the ½-yd. Oliver 88 Hydro-

Trencher, you're equipped for fast, continuous ditching or delicate line repairs. Powerful hydraulic down pressure, deep 12-ft. working range and 170° bucket rotation get jobs done in a hurry while savings mount.

Only Oliver gives you the bonus work value of *two* complete hydraulic systems on the Hydro-Trencher for amazing control and the ability to do any *two* operations at once without pressure loss. What's more, with

Oliver's hydraulic stabilizer bar, you have the stability for full loads without any tipping tendency. For swing loading work, you merely turn around the same bucket. How's that for job versatility?

Whatever your digging and loading requirements, by all means investigate the Oliver Super 88. Your choice of gasoline or diesel engines. See your Oliver Industrial Distributor for a demonstration.



THE OLIVER CORPORATION

400 West Madison Street, Chicago 6, Illinois

a complete line of industrial wheel and crawler tractors and matched allied equipment

*** FIRST CHOICE
FOR SANITATION
AND SAFETY...**



**SWIMMING
POOL
FITTINGS**

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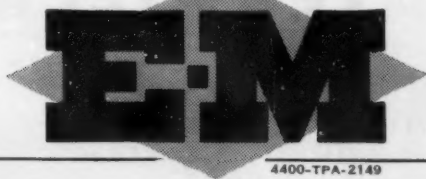
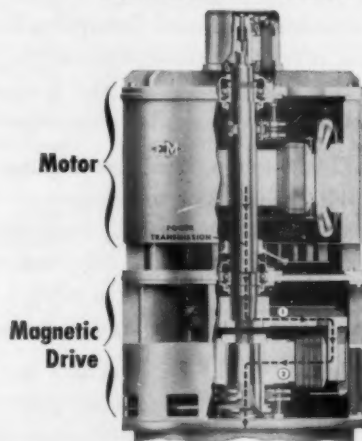
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ENGINEERING IN RURAL COUNTIES

GEORGE DEIBLER, St. Louis County Engineer, Duluth, Minnesota

THE EVERY DAY problems that now confront the rural counties make it essential that they have adequate engineering service. This is especially important in the field of highway engineering where counties must be in a position to plan and construct a system of local roads that will accommodate the ever-increasing traffic. It has generally been conceded that the County level of government is in most instances, the best unit of local government to be charged with the responsibilities of furnishing the public services that are required by the local residents. Where the County form of government is weak there is a natural tendency to transfer the local jurisdiction to the State Government. Therefore, if Counties are to survive as the vital unit of local government then they must be capable of solving adequately the problems that are rightfully theirs.

In the construction and maintenance of county highways there is a great need for good engineering services. County Governments are becoming more complex each year and they need qualified officials to study and analyze the economic changes and recommendations for future planning and development. In addition to the responsibility of supervising the highway department, the county engineer should be a leader in the county government; and he should be capable of planning and directing the construction of airports, public buildings, drainage systems, water controls and many other projects where engineering services are so essential.

Nearly all engineering work on the local level is closely related to the same type of work on the state



● TWO-COURSE road mix bituminous surface on road to taconite mining area in St. Louis County is typical of County Federal Aid Secondary Projects.

level and the engineer must work in close cooperation with the higher agencies. The only proper method of developing a system of main county highways is by studying the development of the state highway system to assure an integrated network of roads that will lead and direct traffic along the channels best suited to provide adequate service.

The Federal Aid Secondary highway program, which is now well established and will continue to expand, requires good engineering to design and construct to the proper standards, highways and bridges that will carry the loads and traffic of the future for this system of roads. The highway industry with its new equipment and technical skills is moving forward at a tremendous pace and only those highway agencies that have adequate engineering service will be in a position to profit by this change.

In the field of construction there is a great need for a more careful analysis and selection of soils for subgrades and bases. This is highly important in order to obtain a high degree of density by proper compaction. Even local roads should now be constructed with a design for a definite axle load. This may properly be under the legal limit but should be adequate to carry reasonable loads at all times and under all conditions. The good old days of closing certain roads or sections of roads for "mud holes", "frost boils" and "soft subgrades" is nearly over and school, mail, and milk delivery routes will have to be open for "business as usual" at all times.

Counties should use engineering services to direct the maintenance of its highway system, supervise the accounting and cost records, and file reports on the accomplishments of

● BRIDGE over Cloquet River is 234' long and has a 27' roadway.





● **STANDARD** concrete box culvert 43' long, 12' by 6', cost \$11,420.

the department. The engineer should assist in the purchasing of all materials and equipment and establish a system of financial control to assure the completion of each project as scheduled. Certainly, one of the greatest advantages of having a qualified engineer is to develop a long-range highway improvement program and currently to extend the program so that a definite number of years' work is always under consideration. This type of work can only be performed by an engineer after a long and detailed study of all economic factors that will eventually affect the trend of traffic in that area. A few years ago a questionnaire was circulated among all of the county highway departments to determine their most critical problems and rate them according to their relative importance. The problem rated as number one was finances.

Local residents are becoming increasingly interested in the operation of their county government and if they are convinced that the funds provided for highway purposes are being expended under the direction of a qualified engineer in an efficient manner, they will support a realistic highway improvement program.

To be successful, a county engineer must have the complete confidence of the Board or Commission under which he operates. It is essential also that the engineer be given sufficient authority to administer properly all of the duties of the office. He should have the ability to maintain good public relations by furnishing factual data to the press, radio and television news agencies and by attending and participating in public meetings, especially where county affairs are

discussed. He should keep up-to-date on all new methods of highway administration, maintenance and construction and be informed on new materials and equipment. The engineer should recommend to the proper authority the changes needed in existing legislation or new legislation that would be beneficial to the county. There is a vast difference between being an engineer in a large organization such as a state highway department, where duties are well defined and where specialists are available for assignment to cover unusual problems, and a county engineer where he alone is primarily responsible for all phases of highway work.

A complete knowledge of the topography, soil and natural resources are essential and this can best be obtained by an engineer after a detailed study over a period of years. For instance, great stress is now being placed on the conservation of both surface and sub-surface water. The economic future of many communities may depend to a large degree on the availability of an ample supply of water for industrial and residential expansion. The engineer should have full and complete information on this subject and be prepared to make recommendations to the proper authorities whenever the interests of the county or its residents are concerned.

Since the end of World War II there has been a trend to locate new residential areas in the rural sections adjacent to the cities. This has created a whole new series of conditions and requires land use studies, zoning and a county plan of the anticipated expansion of housing or residential projects. Often these sites are on lands where the topography, soil and drainage conditions are far from ideal. The street improvements are usually designed to give some appearance of an urban section with a hope of obtaining road service on the basis of rural section costs. This is just another field in which competent engineering services are required.

Engineering Costs

In any discussion of this kind there is always the question of the costs involved and how much a county can afford to spend for such engineering services. The question might well be reversed and seek an answer to the question of how much will it eventually cost the county not to have an adequate engineering staff. Certainly every county that has a highway organization can afford to have an engineer. In obtaining services of a consulting engineer on a fee or percentage basis the work is generally confined to a specific project. These projects are usually of a considerable size and the costs are not comparable to an organization such as is being discussed here. There does not appear to be very much information on engineering costs available for the reason that each county has its own type of organization. Some counties may substitute non-technical help for certain positions while others utilize their engineering personnel to direct various activities of the county other than highway improvements.

Having held the position of county engineer for many years in a progressive county, the writer could be prejudiced, but in his opinion there is no substitute for good and adequate engineering services and, whatever the cost may be, it is one of the most essential services of county government. In this county we spend approximately 7 percent of our total construction and maintenance funds for engineering. As previously stated this is not all strictly for highway engineering but rather for an engineering staff that is adequate to perform all of the administrative and engineering duties of the department. If this expense were applied only to highway improvements, the cost would drop to 5 or 6 percent. It would, therefore, seem reasonable to assume that a range of 5 to 7 percent would be a fair estimate of the cost of providing this service.

● **FIRST** stage in construction of a county road shows general terrain and topographical features in St. Louis Co.



● **SECOND** stage in construction of road shown at left includes widening and graveling; paving may be placed later.



SEWAGE TREATMENT

on the

NEW YORK THRUWAY

IRWIN P. SANDER,

Senior Sanitary Engineer,

New York State Thruway Authority

BECAUSE the locations of service areas on toll roads are selected for the convenience of the motoring public, it is not always possible to secure sites that are ideally situated from the standpoint of sewage disposal. The sewage treatment facilities which must be provided, therefore, are quite often much more expensive because of the lack of availability of large sized natural water courses.

On the New York State Thruway these service areas are generally within a thirty minute drive of each other. Receiving streams in the area of the sites selected for these service areas were generally quite small. It was therefore necessary in most cases to have the highest degree of treatment available.

The quality of the effluent required was determined by the engineers of the State Department of Health, so as not to contravene the standards which have already been established or which might be established for the receiving streams under the conditions of the New York State Water Pollution Control Act.

At three locations on the Thruway, Ardsley, Ravena and DeWitt, the Turnpike Authority was able to site these areas so as to be a tributary to municipal sewage treatment facilities. Comminutors, digesters and primary clarifiers were used at all other service areas. There were 19 trickling filters used and 17 secondary clarifiers. Dosing tanks and sand filters were used at 10 service areas and chlorine contact chambers were used at all areas but the three that could be served by municipal systems.

At the start of design, very little data was available as to the flows



● SEWAGE treatment plant serving the New York Thruway at Chittenango, in central New York State. Note modern equipment and pleasing design of the plant.

that might be expected at such sewage treatment plants. In addition, it was necessary to design a plant with sufficient capacity to take care of the anticipated needs of the motoring public for a period of 20 years hence. After much discussion, it was finally decided that at all secondary and tertiary treatment plants a high rate trickling filter plant would be installed. It was believed that this type of plant would probably be most able to take anticipated peak loads that would develop because of the traffic pattern that might be expected. Although no accurate flow data has as yet been collected, it seems that the

flow pattern will be quite dissimilar from that which is obtained from a normal sanitary sewage system. It appears that there will be two peaks, one at noon which will be quite high and a second at the dinner hour, with low flow during the other hours of daylight and practically zero flow during the night.

Sewage from the restrooms and restaurant kitchen reach the sewage treatment plant in a relatively fresh state as the plants are located within 500 feet of the restaurant proper. Oily wastes from the service stations are excluded from the sanitary sewer system and are collected in

Table 1—Service Areas on the New York Thruway

Service Area	Milepost	Lane			
Schuyler	227.1	W			
Clarence	412.1	W	Indian Castle	209.9	E & W
Pembroke	397.4	E	Mohawk	171.8	E
Ontario	375.6	W	Pattersonville	168.2	W
Scottsville	365.7	E	Guilderland	152.8	E
Seneca	349.5	W	Ravena	130.0	W
Clifton Springs	337.1	E	New Baltimore	127.1	E
Junius Ponds	323.8	W	Malden	103.3	W
Port Byron	310.2	E	Ulster	96.2	E
Warners	291.5	W	Modena	65.8	E
DeWitt	279.5	E	Plattekill	64.8	W
Chittenango	266.4	W	Sloatsburg	33.2	E & W
Oneida	244.0	E	Ardsley	6.1	W

a drainage pit which is emptied periodically by the service station operator.

At all locations, with the exception of the Warners and Ulster sites, the flow of the sewage from the service area to the plant is by gravity. At the Warners site, a pneumatic sewage ejector lifts the sewage to the treatment plant which is located at a considerably higher elevation. At the Ulster site, there is gravity flow from the service area to the treatment plant where two alternating sewage ejectors lift the sewage to the primary clarifier. At

final process is post chlorination. In the first method the sewage is comminuted and then by-passes the rest of the treatment units and goes directly to the chlorine contact tank. In the second method the sewage is comminuted and then goes to the digester for predigestion. It then may by-pass the rest of the treatment units and go directly to the chlorine contact tank. The third method consists of comminution, predigestion, thence to a primary clarifier and then to the conventional secondary treatment units and the chlorine contact tank. The

plants the Shook or direct recirculation method is practiced. This method was chosen because the patent rights on it had run out at the time of the design of the plants and it therefore would afford maximum competition between various equipment manufacturers. This fact is highly important in New York State whenever a state agency is involved.

In the first five plants that were built, namely Junius Ponds, Ontario, Clifton Springs, Chittenango and Guilderland, chlorination, both pre and post, is accomplished by means of hypochlorinators. Because of the hardness of the water, it has been found that sodium hexametaphosphate has to be used in order to prevent deposits in the chlorine lines. This together with the price of the hypochlorite, the manual labor required to prepare the chlorine solution and to make sure that the barrels are filled during the period when no one is in attendance at the plant, makes this method of chlorination quite expensive and it is therefore hoped that in the near future these plants will be converted to gas chlorinators which were installed in the remaining plants.

Trickling Filters

A unique feature of the trickling filters is the fact that they all have wooden covers and ventilation is obtained by means of a draft fan at the cone of the cover which draws the air from the outside through four vent pipes from the bottom of the filter and then out to the atmosphere. This draft fan affords positive ventilation and therefore no odors have been detected in the trickling filters. Due to the close proximity of the sewage treatment plant to the service area, one of the features that has been used to protect the motoring public should they wander into the area, is that all units with exposed water surfaces have wooden covers placed on them. These wooden covers are removable and serve two purposes. One is to protect the public and the second to try to trap any odors that might be given off by the sewage.

The sludge digesters are unheated, fixed cover tanks with scum and scraper mechanism. By proper manipulation of the valves in the pump house, the sludge may be recirculated within the digester. A novel feature of the plant is the disposal of the sludge that is collected in the digester. No provision

(Continued on page 198)



● AERIAL view of the Junius Ponds Service Area, 323 miles from New York. The sewage treatment plant in the background is circled in green.

the primary treatment plants the sewage is first comminuted and then may enter either the digester for predigestion, flow directly to the primary clarifier or by-pass both these units. Chlorine for odor control may be introduced at the influent end of the primary clarifier, while post chlorination is accomplished in the chlorine contact tank so as to insure a disinfected effluent reaching the receiving stream.

Secondary Treatment Plants

In the secondary treatment plants, because of unique design features, it is possible to run the sewage through the plant by five different methods. In all of these methods the first process that the sewage undergoes is comminution and the

fourth method consists of conventional treatment that is comminution, primary clarifier, trickling filter, secondary clarifier, and chlorine contact tank. The fifth possible method of flow which is incorporated only in the plants built during the later stages of the project is as follows: Comminution, predigestion, and then directly to the wet well to be lifted to the trickling filter thence to the secondary clarifier and finally to a chlorine contact tank. In the tertiary plant a sand filter has been placed after the secondary clarifier and before the chlorine contact tank. This sand filter will be used only during the summer months when the stream flows are low and a high quality effluent is desired.

In the high rate trickling filter



PRECAST

Concrete Pedestrian Bridges BUILT OVER EXPRESSWAYS

ARDIS WHITE and WILLIAM B. PURNELL, Associate Professors, Dept. of Civil Engineering, University of Houston

THE CONSTRUCTION of expressways in major cities frequently creates serious problems in crossing of these expressways by pedestrian traffic. The City of Houston recently constructed two precast concrete pedestrian bridges to solve a problem of this type. A short distance west of the downtown Houston district lies the San Felipe Courts, a large low-cost housing

project which is separated from the Dow Elementary School by Buffalo Drive and Memorial Drive, two of the major expressways in the City of Houston. The construction of the pedestrian bridges described in this article permit children from the San Felipe Courts to walk to school without crossing any streets which contain an appreciable amount of traffic.

Because of the large amount of traffic on both Memorial Drive and Buffalo Drive it was necessary that the construction of these pedestrian bridges be carried out in such a manner that the traffic on these expressways would be inconvenienced to the smallest degree. Consideration of this fact dictated to a large extent the construction procedures to be used, and thus of ne-

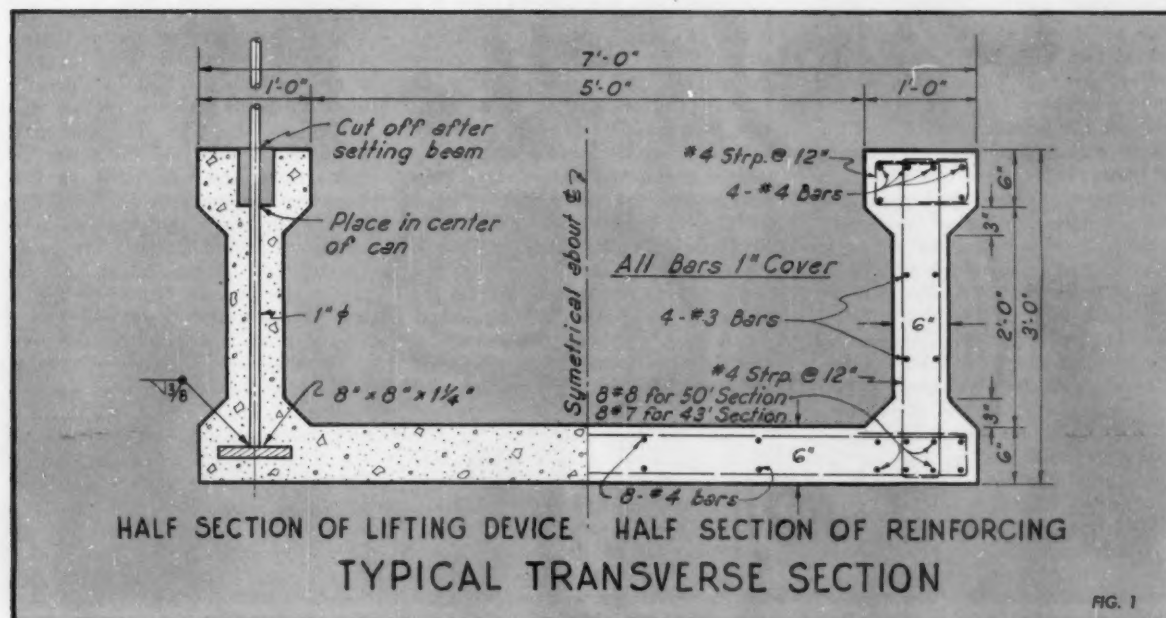


FIG. 1

● TO AVOID interference with traffic on expressway, bridge sections were precast and set in place on piers by a crane.

cessity affected the design features also. After consideration of the problems involved in construction it was decided that the most practical solution was to precast the main bridge sections and then to set them on the piers.

The right half of Fig. 1 shows the reinforcing steel and essential dimensions of a typical cross-section of the five precast concrete spans used in the two bridges. The solid rail beams at the sides of the walkway sections were made of such a height to provide strength for carrying the moment and shear of the dead and live load and also to provide a reasonable height of solid rail for the safety of children using the overpass. The pedestrian bridge across Buffalo Drive contains three spans, the end spans each being 50 ft. in length and the center span 43 ft. The pedestrian bridge over Memorial Drive consists of only two spans, each 43 ft. in length. The precast concrete span sections rest on single column T-shaped piers, the columns being tapered so as to be smaller at the top than at the ground line. These columns are rectangular in cross section, 2'0" x 2'6" at the ground line and 1'6" square at the bottom of the cap which supported the precast sections.

The foundation for these bridges consists of bell bottom piers which are made by drilling a vertical hole in the ground and then excavating with special equipment a bell shaped cavity at the bottom of the hole to provide a larger bearing area. The two center piers at Buffalo Drive and the single center pier at Memorial Drive each contained two such bell bottom shafts below ground. These twin shafts were connected by a tie beam just beneath the ground surface, and the single rectangular tapered columns of these center piers was placed in the center of these tie beams. The main purpose in using two shafts and the tie beam was not to carry the vertical load, which was relatively small, but to take care of the large overturning design moment caused by wind blowing on the side of the pedestrian bridge. This wind moment decreases as the top pier is approached, thus permitting the smaller rectangular dimensions used at the top of the columns. All of the columns except the center columns just mentioned rested on single circular drilled shafts which did not have bells at the bottom. The rectangular tapered columns at the ends of the precast bridge rested on 36 in. round drilled shafts. The flat slab stair landing

rested on a 24 in. round column which in turn was supported by a 24 in. drilled shaft. A beam resting on a 16 in. drilled shaft supported the bottom of the lower flight of stairs.

The bottoms of the precast beam sections were cast to a circular form so that when placed on the piers at the desired elevations the bottoms of the beams would make a smooth circular curve. The maximum rise or mid-ordinate at the center of the Buffalo Drive overpass was three feet, this bridge being approximately 143 ft. in length. The rise in the 86 ft. Memorial Drive overpass was 20 ins. The radius of the vertical curve for this bridge was somewhat smaller than for the longer bridge used at Buffalo Drive.

Construction Procedure

The first work done in construction of these bridges was that of pouring the precast concrete main span sections. These sections had to cure for approximately three weeks before they could be lifted from the ground. All but one of the main span precast sections were poured beside the roadways at the construction site so as to be in a convenient location for lifting and placing on the piers. At Buffalo Drive one of the precast sections was poured in one of the two esplanades which separate the three roadways. During the time these sections were being poured the foundations for the piers were being constructed, and by the time the precast walkway sections had cured properly and gained sufficient strength for handling, the piers themselves had aged properly to receive the weight of these precast sections. The precast walkway sections were each lifted by a single mobile crane and maneuvered into position on the piers. Each of the 50 ft. precast sections weighed about 50,000 pounds. The proper positioning of these precast sections on the piers was facilitated by the use of anchor bolts cast in the piers and by masonry plates which were cast in the bottom of the precast walkway sections. The entire operation of lifting the five separate precast walkway sections onto the piers required considerably less than one day. This work was done on a Sunday so as to encounter the lightest possible traffic on the expressways crossed by these bridges. The traffic in each roadway spanned by the walkways was stopped only about an hour, this being the only time during the construction of

these bridges that the traffic in the individual roadways was completely interrupted. At other times during the construction process one of the lanes in a roadway might be closed, but the other two lanes would still be open. It is believed that the construction procedures actually used required about the minimum possible interruption of traffic that would have been possible with any methods of construction of these bridges.

Lifting of the present walkway sections was made possible by means of a special lifting frame and special lifting bars, as shown in the left half of Fig. 1. These lifting bars were placed at four points in each precast section and the top ends of the bars were threaded. The lifting frame consisted of an I-beam and a cross member at each end of the I-beam. The cross members were made of channels placed back to back with a spacer which permitted the four lifting rods to pass between these channels. Large washers and nuts were used to fasten the lifting frame in place on the precast sections. After the precast walkways were placed on the piers the lifting bars were cut off beneath the top of the solid rail beam section, and the holes filled with grout.

Conventional masonry plates were placed on the piers to support the precast concrete sections. A sole plate with rods welded to it was cast in the bottom at each corner of the precast section so that the rods imbedded in the concrete would hold the sole plate in place. This sole plate extended past the side of the walkway section, so as to permit the anchor bolt to protrude through the hole in the sole plate when the walkway section was placed on the pier. The masonry plate on the pier had the same dimension as the sole plate on the walkway section, but the hole for the anchor bolt in the sole plate was slotted to provide for any errors or construction irregularities which might have caused trouble in placing the walkway sections. These slotted holes also provided for expansion of the walkway sections.

The two pedestrian overpasses described in this article were constructed on a lump sum basis, and the total cost of both bridges was \$26,000. The bridges were designed by the Bridge Division of the Department of Public Works of the City of Houston. J. M. Nagle is the Director of Public Works and T. W. Bamberg is the Bridge Engineer. The E-E Company was the contractor who built these bridges.

EMERGENCY AUXILIARY ELECTRIC PLANTS

C. LELAND WOOD,

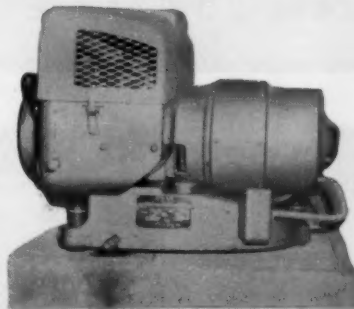
City Manager,
Watertown, New York

OCCASIONAL interruptions of regular electric service have interfered with operations of some of the municipal departments of the City of Watertown, New York. In order to assure continuity of departmental functions, it was decided several years ago to purchase gasoline-electric plants for use during times of power failure.

It appeared advisable to insure the continuance of important governmental functions such as Police and Fire Department activities regardless of the type of emergency, even to the possibility of disaster resulting from war activity.

The first unit purchased was a 5 KW Onan gasoline-electric plant for use by the Police Department. A rearrangement of electric circuits in the City Hall where the Department headquarters are located, permits isolation of the Police offices by operating a special switch. The electric plant was mounted on a light angle iron frame supported by four small wheels for mobility.

It was first housed in the Police garage nearby so it could be quickly moved to a position outside of the Police office where a connection could be made through the attached cable and plug with a special receptacle. Recently the unit was placed in the City Hall basement near the electric service entrance to further facilitate its use with operation through a special switch. The engine exhaust is carried through



● **AUXILIARY** electric plant is installed in Headquarters Fire Station.

a flexible pipe to the outside of the building.

The Police radio station, the teletype machine and office lighting system, which would be inoperative by failure of electric service, continue to function through an emergency period. On the very few occasions when it had to be used, this auxiliary electric plant has proven its worth.

Later, a second unit of similar capacity and make was purchased and installed on a substantial concrete foundation in the basement of the central fire station. On this emergency plant the fire alarm system, the radio station and control headquarters' building service are dependent for continuance of operation if normal electric service fails.

Other Portable Units

A third Onan 5 KW portable electric unit was purchased for use at the City hydro-electric plant for use if an emergency occurs and service is needed in making repairs to station equipment. This unit is mounted upon a small hand truck

so it can be easily moved about the station or loaded for use at another location if desired.

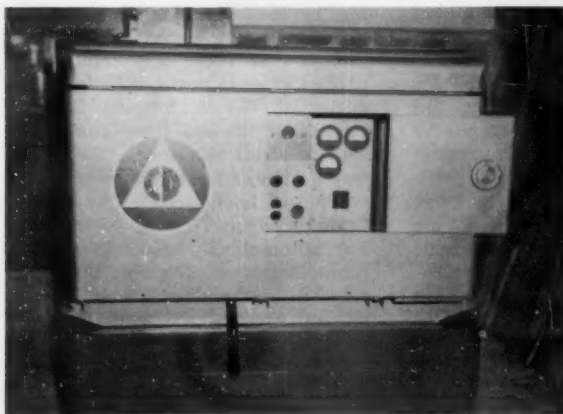
The Water Department owns a portable electric unit which it uses when it is necessary to provide illumination for emergency repair work at night. The department can use the auxiliary unit to furnish energy to operate a portion of its headquarters' building in case of electric service interruption.

Recently a 10 KW Onan electric generating plant has been purchased and installed in the Thompson Park shop building on a concrete base. This unit provides electric energy to operate heating plants in winter, the lighting system for the zoo and other park buildings as well as for operation of the air warning control center located in one of the park buildings.

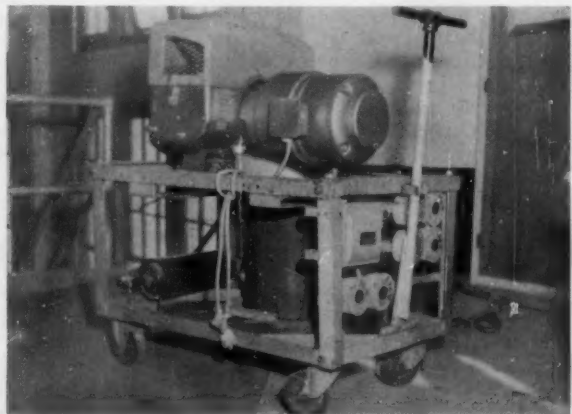
It is planned to install an auxiliary electric plant to serve the Public Works Department headquarters' buildings in the near future so that there may be no interference with its service to the public at any time.

Installing small electric plants at strategic places has provided continuity of municipal activities during the infrequent failure of regular electric service and will continue to assure normal departmental functions in the future. The various plants are tested-operated once each week to insure their satisfactory operation when needed.

We believe the public realizes that this type of insurance is well worth while and appreciate its value as a special public service during emergency periods.



● **10-KW UNIT** in Thompson Park provides electricity for heating and lighting units in Zoo and other Park Buildings.



● **5-KW PORTABLE** generator in Municipal Hydroelectric Plant for emergencies and when needed for making repairs.

MECHANIZING for 3,000,000 MILES

H. A. RADZIKOWSKI

Chief, Maintenance Branch,

Bureau of Public Roads

THE TREMENDOUS task of maintaining nearly 3 million miles of county and local roads in this country is an essential prerequisite to a healthy national economy. It is a costly operation and it must be continuous. Today, it must also be mechanized.

A short time ago, the Bureau of Public Roads made a study of trends in earthmoving costs. The results showed that had it not been for mechanization of excavating operations during the 30-year study period, the cost of moving dirt would be $3\frac{1}{2}$ times the current bid prices. Again, a State highway department made a comparison of the cost of loading windrowed spoil from ditch cleaning operations by hand and mechanically. It was found that the average saving obtained through the use of a mechanical loader was \$152 per mile. On sections where the windrows were heavy, the loader effected savings up to \$431 per mile over hand methods.

The farmers across the right-of-way fences bordering the rural sections of these roads are well aware of the benefits of mechanization. Long ago, they traded their horses for the horsepower under the hoods of their tractors. And it may be that at times they have reason to be critical when they see their tax moneys being spent on operations performed by picks, shovels, scythes and post-hole diggers in the hands of highway maintenance crews.

It is unfortunate, but true, that at the present time these hand methods are necessary along too many miles of our country and local roads. Steep side slopes, boulders and other characteristics prevent the efficient use of modern machinery for many maintenance operations. Before entering into a discussion of mechanized maintenance, therefore, it would be well to consider what can be done to eliminate these obstacles to efficient maintenance.

First of all, it is desirable that each county and local organization



Courtesy Vermont Dep't. of Highways

● SNOW plowing needs are unpredictable. Rental arrangements for extra trucks may offer the most economical solution, but plenty of plows must be kept on hand.

develop a long range plan for improvements to the roads under their jurisdiction. A logical beginning would be to group existing highways into systems taking into consideration the relative volume of traffic, the points connected and the area served. Probably in most instances, designation of a primary system consisting of the most important roads and/or streets and then a secondary system would be sufficient. Only those roads should be included which are essential to the economy and welfare of the people they serve.

When the permanent highway systems have been selected, the order of priority for improvements of each road section should be established. Several years ago the Bureau of Public Roads, in cooperation with State highway departments, developed a system of numerical ratings for highways as an aid in determining the priority for needed improvements. This system is now in use in all States and could be

used, with modification if desired, to rate county and local roads. Essentially, the sufficiency rating system assigns numerical values based on an engineering appraisal of the structural adequacy, safety and services for each highway section. Deficiencies, including those resulting in excessive maintenance requirements, are given a value and the sum of these applicable to a particular section are deducted from a par of 100. A formula is used to weight the resulting sufficiency ratings of all sections in the highway systems in accordance with the volume of traffic carried.

The sufficiency rating system will not automatically produce a long range highway program; but it is an aid in developing one. Other factors, such as the availability of funds, must be considered. Sometimes it is desirable to improve several sections of highway rather than tie up all available funds in one job, such as the replacement of a major structure.

OF HIGHWAY MAINTENANCE

Planning for Mechanization

Once the permanent system of county and local roads has been established and an orderly program of improvement developed, existing maintenance methods and procedures should be examined for the purpose of mechanizing all operations where it is possible to do so. This should be a continuing process so that hand methods formerly required will be replaced by machine methods as improvements are completed.

Careful planning is required in this phase if the full benefits of mechanization are to be realized. Planning might be divided into four major segments as follows: 1) Selection of balanced equipment fleets; 2) organization for mechanized maintenance; 3) managerial control over maintenance equipment; and 4) care of maintenance equipment.

Only the first of these will be discussed here although all are so closely interrelated that it is impossible to divorce one completely from the others.

The importance of proper selection of maintenance equipment for the upkeep of county and local roads is increasing. This is indicated by a comparison between a study of county-owned equipment inventories made by the Highway Research Board in 1948 and a similar one made by the Bureau of Public Roads six years later in 1954. This comparison shows a definite trend toward increased mechanization in county highway department operations. In six years, the number of key equipment units owned by county highway departments rose from 52 to 85 per 1000 miles of road maintained. To put it another way, the average county increased the number of equipment units it owned from 35 units in 1948 to 55 units in 1954.

This is a favorable trend for there are indications that most counties are even now underequipped. For example, they own about one motor grader for each 125 miles of highway maintenance while State highway departments own one for each 75 miles of road maintenance. The State owns a mower for each 55 miles of road in contrast to the county average of one per 384 miles.

States have four times as many loaders per mile of highway to be maintained.

These are indications that the upward trend in mechanization will

It was found that many factors have a decided effect upon equipment needs. Some of these are:

1) Mileage of roads by types of surface; 2) climate; 3) topography; 4)



Courtesy Deere & Company

● **MULTI-PURPOSE** equipment as the versatile front-end loader and the crawler or wheel tractor permit many economies in road maintenance.

continue. Since the investment in equipment is increasing, county and local highway departments will need to consider carefully several factors which may affect proper balance in the fleet as a whole.

Equipment Selection

The Bureau of Public Roads made a study of maintenance methods, procedures and equipment employed in one or more areas in each State. Each area covered a county or a highway district. The maintenance of all roads in each area, as well as the equipment employed by State, county and local highway departments performing the work, was analyzed. The discussion which follows is based on some of these findings. In general, if inventories of equipment are compared where maintenance conditions are quite similar except for one factor, the impact of this factor upon the equipment inventory can be evaluated.

soils; 5) characteristics of area; 6) characteristics of system; 7) jurisdictional factors; and 8) availability of private equipment.

It may be helpful to illustrate how some of the factors have influenced the selection of numbers, sizes, and type of equipment units.

Obviously, the number of miles of roads will affect the quantity of equipment needed. The type of surface will be significant in choosing the proper type of equipment. Table I(a) lists the equipment inventories of two county maintenance organizations. Table I(b) gives the mileage of roads by types of surface maintained by each unit. The major difference between the two is the mileage of highway maintained by each.

It is interesting to note that the number of units of a particular kind of equipment owned by Unit A, in quite a few instances, is approximately in the same proportion to the number owned by Unit B as

Table 1 (a)—Equipment Owned and Mileage Maintained by Counties Designated as A and B

Type of Equipment	Number of Pieces	
	Unit A	Unit B
Cars	9	2
Trucks	102	16
Graders, motor	21	5
Tractors, crawler	18	3
Scrapers	10	1
Distributors	3	1
Rollers, power	2	1
Brooms, power	2	1
Mowers, power	22	6
Mixers, concrete	2	1
Spreaders, sand	4	1
Plows, snow, V-type	55	7
Trailers	5	1
Conveyors	1	1
Graders, elevating	—	1
Plants, screening	—	1
Plants, screening and crushing	3	—
Shovels, power	4	—
Plants, bituminous	1	—
Compressors, air	2	—
Graders, pull type	4	—
Plows, snow, rotary	3	—
Heaters, bituminous	3	—
Markers, traffic line	2	—
Boilers, steam	2	—

Table 1 (b)—Road Mileage Maintained, Units A and B

Type of Surface	Mileage	
	Unit A	Unit B
Earth	63	9
Gravel	892	319
Bituminous	494	36
Concrete	67	—
Total	1,516	364

are the mileages of the respective units. There are exceptions. Unit A has 1½ times as many trucks per mile of road as Unit B because with a much greater mileage of roads to maintain, more crushed gravel and stone needs to be hauled and the investment in extra trucks, power shovels, and crushing and screening plants is justified.

Also, Unit A has about twice as many V-type snow plows per mile of road maintained as Unit B. Unit A already had extra trucks available and for a relatively small investment in plows it could provide

a greater service to traffic and reduce the idle winter time of the extra trucks.

Another effect of mileage and type of surface is reflected in these inventories. Unit B owns one distributor and one roller which are used primarily to maintain 36 miles of bituminous surface. On the other hand, Unit A has one distributor for 165 miles of bituminous surface and one roller for each 247 miles and in addition uses them on bituminous mat construction.

Unit A has 67 miles of concrete roads and, therefore, air compressors for pavement drilling and breaking operations in removing damaged sections, and bituminous kettles for heating crack and joint filling material are provided. Because

or ice problem and so does not need snow plows or sand spreaders. Other variations also show up under careful analysis. Due to differences in climate, Unit C must mow grass and weeds every two weeks for 8 months of the year, while Unit A mows only twice a year. Unit C confines its mowing to approximately 410 miles of the most heavily traveled roads, while Unit A mows all of its 1,380 miles of rural highways.

To compare the mowing work loads of these units, it is necessary to convert to a common denominator. For mowing, the swath-mile is commonly used. This is a strip one mile long by one swath wide. Unit A mows 19,300 swath-miles annually while Unit C mows



● PATCHING is an essential in maintenance and mechanization can reduce costs and speed up work. Here a Huber-Warco maintainer rolls patches on an Ohio street.

Unit A has 494 miles of bituminous roads, it was found advantageous to own a bituminous plant to produce the patching materials needed. Unit A also owns traffic-line marking machines because the mileage of paved surface is sufficient to justify their ownership.

Some effects of climatic conditions upon the selection of a balanced fleet are readily discernible in comparing equipment inventories. Unit C (equipment list not shown) is a maintenance organization in the southern part of the United States which has no snow

28,000 swath-miles annually. The mowers in Unit A each average 600 hours of use annually and 3.3 swath-miles an hour while those in Unit C average 720 hours of use a year and 3.9 swath-miles per hour. In Unit A, weeds must be mowed to the full right-of-way width so that they will not cause snow drifts. Mowing of roadsides is slower than mowing shoulders because of obstacles.

Motor graders in both units are used principally to clean ditches and blade earth and gravel roads. On a mileage basis, both appear to

have about the same load. Because of the 15-inch greater rainfall in Unit C, the work load is greater; ditches must be cleaned more frequently and the gravel roads bladed after each rain. The milder climate enables Unit C to carry on these operations all year round and, since the work load is spread over this period, a smaller number of motor graders are used.

The effect of soils on highway maintenance is clearly demonstrated in two units (equipment not listed here) located in adjacent States. In Unit E surface deposits of clay of excellent quality for stabilization, and of sand and gravel, are found at several locations. In Unit F, small-sized river gravel is available but the only binder is a

more normal conditions needs only one for every 75 miles.

Urban Maintenance

Striking contrasts also will be found in comparing the equipment used for maintaining rural roads with that used in urban areas. Table II for Unit G shows the equipment fleet used in maintaining 286 miles of streets in a city of 77,000 population. In such urban areas, contractors are generally available who are equipped to perform many maintenance operations, as sealing bituminous surfaces, large scale patching and production of aggregates and patching materials. Usually prices do not exceed the cost of performing the work by force account and Unit G

streets, particularly in business sections, because the entire street is needed for normal uses. Streets must be cleared with the greatest possible speed. When ice forms, it should be treated quickly because of the high density of traffic on urban streets. Consequently, relatively large numbers of plows and spreaders are owned by Unit G. Sidewalks also must be cleared and special equipment is needed for this work.

Shade trees are a prized asset in any city, especially in residential areas. Most cities also take pride in keeping their streets clean. Because it is responsible for these operations, Unit G owns such items as tree sprayers, leaf pickers and road sweepers. Mowing requires different equipment in urban areas. The mowers used by Unit G are lawn-type power mowers, whereas the sickle-bar type is most commonly used in rural areas.

Maintenance of streets in business sections of cities is often per-



● HOT OR COLD bituminous patching or paving material is produced quickly with this Littleford portable mixing unit, completely self contained, with 200-gal. tank.

fine loam. During the hot, dry summer months, the loam binder is eroded by the wind and a loose gravel surface results which is very hazardous to traffic. To reduce the hazard, it is necessary continuously to blade the loose gravel off the surface into windrows along the edge of the road. When the fall rains start, Unit F has to replace the lost binder and keep blading the windrowed gravel back onto the surface as fast as it can be absorbed. To perform this additional work requires one motor grader for 20 miles of road, while Unit E with

can contract those maintenance operations that can be measured. It need not own and operate many such units as distributors, concrete and bituminous plants and aggregate production equipment.

Snow removal in cities is far different than in rural areas. Snow can be advantageously removed by rotary snowplows equipped with chutes which load the snow directly into trucks or the snow can be pushed into windrows from which it is picked up by snow loaders and deposited in trucks. It cannot be stored in any quantities along most

Table II—Equipment Used by Unit G to Maintain City Streets

Type of Equipment	Number of units
Cars	8
Trucks	74
Graders, motor	3
Tractors, crawler	2
Rollers	3
Mowers	10
Welders	2
Spreaders, sand	13
Snowplows, blade	90
Trailers	6
Shovels, power	2
Compressors	6
Loaders, aggregate	8
Snow plows, rotary	6
Heaters, bituminous	1
Markers, traffic-line	1
Spreaders, stone	2
Pavers, bituminous	1
Loaders, snow	4
Eductors	4
Tractors, wheel	4
Hone, road	1
Sprayers, tree	10
Snow plows, sidewalk	16
Pumps, sewer	4
Rollers, trench	1
Rollers, sidewalk	2
Leaf pickers	4
Turbines, sewer	2
Machine, sign-painting	1
Plant, lighting	1
Sweepers, road	4



● DITCH cleaning and shoulder improvement are essential procedures which have been speeded by the use of modern motor graders, such as this Allis-Chalmers unit.

formed at night. Special lighting equipment is sometimes needed for this work. Traffic and street lights, as well as signs and pavement markings, are a larger maintenance problem in cities.

Characteristics of System

Characteristics of a system of roads have a decided effect upon the equipment needs. Currently, the most serious problem faced by maintenance engineers arises from the amount of deficiencies in the roads to be maintained.

The effect of deficiencies is readily illustrated. On a section of highway built in 1924 and 1929, the grade line was located below the level of the adjacent fields. The annual cost of snow removal was \$296 per mile. On a nearby parallel section of road the cost of snow removal was only \$20 per mile the same year. The road with the lower

cost has a streamlined cross section with the grade line elevated above the surrounding fields. The older section interrupts the flow of wind causing eddies with the result that snowdrifts form in the road. The modern section, on the other hand,

offers little resistance to the wind which tends to sweep off any snow on the surface. In an average year, 25 round trips of a snow plow were required on a deficient section of highway; whereas only 9 round trips were needed on a nearby section of modern design.

Inadequate width of pavement is a deficiency that increases equipment needs by causing an abnormal amount of shoulder maintenance. Traffic off the pavement edges causes ruts to form which are a hazard and interfere with drainage. Where traffic is heavy, shoulders must be maintained constantly and equipment must be increased over normal needs.

Winter maintenance is one of the most unpredictable work loads. If there are sufficient trucks to meet maximum snow removal needs, there is a problem in finding sufficient work for them during the spring, summer and fall. In many areas, snow conditions make heavy trucks desirable for snow plowing, but these trucks have such limited use in other maintenance operations that ownership is very costly. To avoid such costs, many organizations are now buying extra snow plows and utilizing trucks owned by private contractors. Contractors are glad to furnish trucks and other equipment, as well as operators, because it cuts down idle time during the slack season and enables them to hold an organization together throughout the year.

In agricultural areas, advantage is taken frequently of the fact that modern farm operations are mechanized and many farmers own trucks, tractors, mowing machines, etc. Many local highway maintenance organizations have successfully reduced their equipment needs by paying farmers to perform such operations as mowing roadsides,

TABLE III
Major Equipment per 1,000 Miles of Road Maintained
(in a State performing all maintenance with its own forces)

Type of Equipment	Number of Pieces
Automobiles, station wagons, pick-ups	24
Trucks (all types)	78
Graders, motor	20
Graders, tow, including maintainers	26
Distributors, bituminous	4
Rollers, power and pull	7
Tractors, crawlers and wheel	20



Courtesy Sunflower Industries, Inc.

● **ROADSIDE** maintenance costs may be materially reduced if they are properly graded and are clean enough to permit machine mowing, as with this 80" rotary.



Courtesy Caterpillar Tractor Co.

● **MOTOR** graders are the workhorses of maintenance organizations. Here are two units working tandem on the finishing stages of a county road job in Arkansas.



Courtesy Highway Equip. Co.

● **SPREADERS** are used for ice control, stabilization and seal coating.

dragging and blading roads, hauling materials, etc.

Many maintenance organizations have an equipment rental system under which projects or sections of road are charged for the equipment used to maintain them. The prime function of such a system is to accumulate funds to pay the cost of operating, maintaining and repairing equipment and to purchase new machines as the old ones wear out. Where policy makers recognize this principle, the equipment department can be a self-sustaining organization.

Some organizations, however, operate an equipment rental system merely as a means of distributing expenditures to projects. Purchases of equipment are made from funds appropriated for this purpose. This system is not as flexible and does not permit certain economies as readily as that in which a revolving fund is available for equipment purchases as needed to balance the fleet and to take early advantage of new developments.

When the engineer has inadequate funds to purchase equipment, the selection, care and operation of such equipment as he can get is even more important than usual. Sometimes he must utilize various alternates in lieu of buying the equipment he needs. He also must develop management practices which will insure the fullest utilization of all equipment units.

HOW TO IMPROVE MORE MILEAGE ON A FIXED BUDGET



● FUNCTION of calcium chloride is to maintain the proper moisture content in the binder, providing the cohesion necessary to give a good wearing surface.

F. R. SPROULE

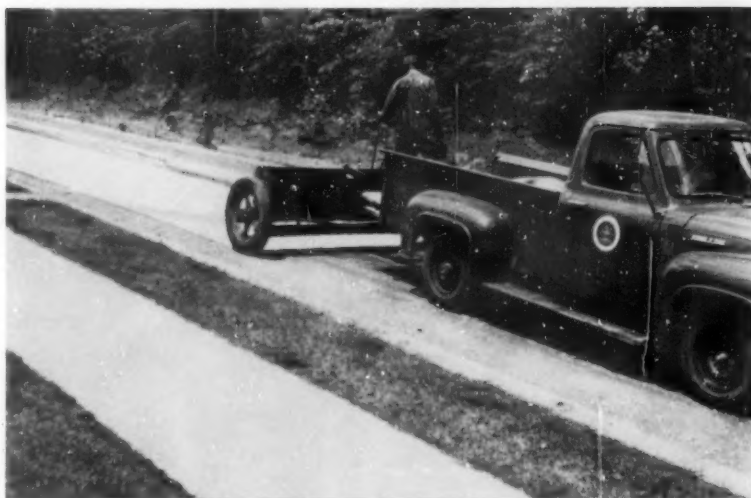
Wyandotte Chemicals Corp.

TO AN ENGINEER the highway problem is an equation with three variables: First, he doesn't want to spend money that will give temporary benefit but increase his problems over the long pull; second, he wants to satisfy the majority of the property-owners and vehicle drivers in his area; third, he must keep expenditures within a fixed budget.

With traffic loads on the increase, most highway planning today includes a program of improving gravel or stone traffic-bound roads or streets for bituminous surfacing. Chances are that roads slated for such improvement have only a thin layer of gravel or stone and must be built up to the thickness required of a base for blacktop.

A time-tested and very satisfactory procedure is to place this build-up of gravel or stone each year on a limited mileage most in need of higher type surface. These roads are then given a year under traffic, a

sort of shake-down period during which defects will show up and can be corrected. The next year they are surfaced, at the same time as another batch of roads is prepared,



● PUBLIC WORKS Department of North Carolina City uses truck-drawn spreader to apply calcium chloride to streets to lay dust, reduce maintenance.

following a long-range plan fitted to revenue expectations.

The exact thickness and nature of the gravel, stone, or other material to be used will depend somewhat on local conditions—that is, on what durable materials are readily available at reasonable cost, past performance of such materials, climate, and so on. And of course the fundamental requirement of good drainage must be attended to first of all.

A dense-graded soil-aggregate is the best choice in most locations, offering simplicity and economy in handling and placing. Crusher-run crushed stone and other materials may often be used without the presence of soil binder since in many cases enough binder fines will be present. A good general specification to follow is the AASHTO grading shown in Table 1.

Where the gravel or stone needs additional binder, soil may be blended either by the plant-mix or

Table 1—Soil-Aggregate Grading

Sieve No.	Percent Passing
1-inch	100
3/8-inch	50-80
No. 4	35-65
No. 10	25-50
No. 40	15-30
No. 200	5-15

The fraction passing the No. 200 sieve should be less than one-half of the fraction passing the No. 40 sieve. The fraction passing the No. 40 sieve should have a liquid limit not greater than 25 and a plasticity index not greater than six.



● USING two pounds of chloride per square yard of surface, the cost applied will be four or five cents per square yard or about \$500 per mile of roadway.

road-mix method. In either case, water usually has to be added to permit proper compaction. Many engineers also add calcium chloride. A good description of these procedures is given by H. C. Clemmer in his article "Calcium Chloride Stabilization as Related to Soils Bases," in *PUBLIC WORKS* for June, 1956. This article covers the construction procedure in detail, and is fully applicable whether calcium chloride is used or not.

Once the soil-aggregate or crushed stone is in place and under traffic, the engineer's next concern is to keep it in shape and prevent loss of material until a year later, when it will be given the bituminous surface. Neglect might mean loss of as much as one inch of material blown off and displaced by weather and traffic. Dust will be an annoyance to residents along these roads, as well as a traffic hazard. Treatment with calcium chloride is a commonly used method of preventing these difficulties. Savings in blading and in loss of material generally will about equal the cost of the calcium chloride.

Chloride Treatment

If the aggregate has been treated with calcium chloride, a surface application of $\frac{1}{2}$ lb. per square yard of calcium chloride should be applied after final shaping and compaction. During the remainder of the summer and fall, and the next spring, further $\frac{1}{2}$ lb. applications should be applied when signs of dusting ap-

pear. Normally, one or two such applications can be expected per year. If no calcium chloride has been used in the aggregate, the procedure is the same except that the first application should be 1 lb. of calcium chloride per square yard. Most equipment used for dispensing chemicals for ice control may be used to apply the calcium chloride.

Assuming that 2 lbs. of calcium chloride per square yard are used in the year's interval between placing the aggregate and the bituminous surfacing, the cost of the calcium chloride will be from four to five cents per square yard, applied, or about \$500 per mile.

Let's look at a case where an engineer is in charge of a 1600-mile system, including 100 miles of paving. He estimates that he should pave another 150 miles as soon as possible, and his long-range goal is 500 miles, to be done at a rate of 50 miles a year.

At present his construction and maintenance procedure includes the

operations of grading, draining and surfacing the more heavily traveled roads with about six inches of aggregate. It is planned later to cap these roadways with a double surface treatment of bituminous material. Some 50 miles of highways now have the six inches of aggregate, and the engineer plans to prepare a similar 50 miles during the year for next year's paving.

Where to Get the Money

How can he maintain a progressive construction program, satisfy more people in his area, and still not exceed his budget? He can do one of two things: He can conduct his program of surfacing 50 miles of roads at a cost of \$5,000 per mile; this will amount to \$250,000 which is his paving budget.

But there is another way of proceeding which will produce more satisfactory results and still not disturb the budget. He can cut \$25,000 (five miles) from his paving program and use it to treat with calcium chloride the 50 miles of 6 in. base to be placed in the current year. By maintaining the wearing course of these unpaved roads with calcium chloride each year, loss of material is practically eliminated, defects may be remedied at minimum cost and ultimate paving will provide a better surface for longer periods. The first condition named at the beginning of this article is satisfied, and the engineer is assured that his program is ethically and professionally sound.

Further, he'll be providing 45 miles of paving, and 50 miles of smooth dust-free calcium chloride-treated surface, for a total of 95 miles improved, in place of only 50 miles. This fulfills the second requirement, His "customers" will be happy. Best of all, he'll be keeping within his budget, meaning that his bosses will be pleased. The three conditions are met; the equation solved.



● MOTOR grader brings soil fines in from the shoulder area.

ONE HUNDRED AND FIFTY

The Coast and Geodetic Survey stands ready to strengthen and perpetuate your survey

REAR ADMIRAL H. ARNOLD KARO

Director,
U. S. Coast and Geodetic Survey

IN 1957 the Coast and Geodetic Survey of the United States Department of Commerce celebrates 150 years of service to the nation. This great record of progress dates from 1807 but the value of the extensive national network of horizontal control was not truly recognized as a real asset by the local surveyor until the early 1930s.

The State of Maryland authorized some years ago the necessary surveys for the acquisition of a 650-acre proposed state park. A contract was entered into with a state registered surveyor to establish the boundary and a plat of the parcels of land involved. When this phase was completed, a second state registered surveyor was engaged to make the topographic survey.

In keeping with the state's survey policy of using Maryland State coordinates, the horizontal control was based on Coast and Geodetic triangulation. Both the horizontal and vertical control for these surveys were based on the C&GS station GATE located near the southwest boundary of the tract. As the topographic survey progressed, the second surveyor reported a discrepancy in the location of some of the northern boundary corners. Both surveyors naturally believed that they had used proper methods and reasonable care in their work and neither one thought that he could be wrong.

After studying the matter, a civil engineer representing the State of Maryland, decided that an independent check traverse from a C&GS triangulation station located about 2000 feet north of the corners in question should be run. This decision was based on economies, with the belief that this traverse would be cheaper and quicker than



● SURVEY party of the Coast & Geodetic Survey running line of levels into LaGuardia Airport, New York City. Level network now covers the entire nation.

checking all the computations or resurveying the contractors' traverses.

A field party was formed from representatives of both contractors and of the State. After locating the desired triangulation station, the check traverse was completed in a couple of hours and the work of the second surveyor was proved to have been correct. This enabled the first surveyor to locate his error in his boundary computations and to revise his work. The boundary contractor was afforded an impressive demonstration of the value of tying into all triangulation stations of the national net that were avail-

able near his survey jobs. This experience demonstrates one of the uses that may be made of geodetic control, and shows a double, or hidden value of the state coordinate system. The total cost of this job was reduced by the use of state coordinates, and the new control established for the project was permanently marked for possible use in future work.

Following the inception of the "Survey of the Coast" in 1807, Ferdinand R. Hassler, a Swiss engineer, brought to the New World the first precise instruments for astronomic and geodetic surveys. Despite many set-backs and stub-

YEARS of ACCURACY

born early opposition to his methods, Hassler was able to execute his plans for accurate surveys which could be extended over large areas involving the necessary consideration of the size and shape of the earth. From this work undertaken during these formulative years by the first Superintendent of the Survey grew the expansive networks which now extend over the entire nation.

Scope of the Work

The scope of the work today follows much the same scientific approach as was laid down by Hassler, and includes the measurement of

base lines, astronomic observations, triangulation and traverse work, precise leveling, and the measurement of the force of gravity. The early surveys were originally designed for control of coastal and hydrographic surveys, but in 1871 the activities of the "Coast Survey" were expanded to make geodetic connections between the Atlantic, Pacific, and Gulf coasts of the United States. In keeping with this expanded responsibility the name of the Bureau was changed in 1878 to the present name of "Coast and Geodetic Survey."

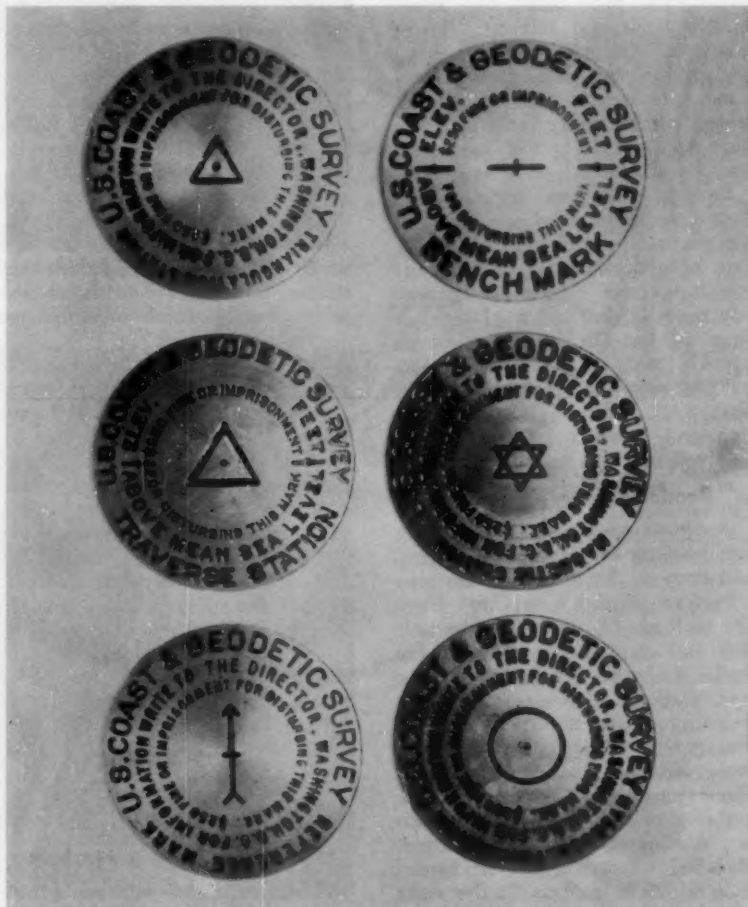
Throughout the intervening years, the plan for systematic horizontal

control coverage of the country has been modified from time to time in order to meet the demands of the national expansion and development. The network of horizontal control is based on a common datum known as the North American Datum of 1927. The latitude and longitude of the Coast and Geodetic Survey station MEADES RANCH located near the geographical center of the United States in Kansas is the origin of this continental datum.

The present plan is to cover the entire nation with a network of triangulation stations spaced at least $7\frac{1}{2}$ miles apart to provide at



● BILBY portable steel triangulation tower is widely used by C & G S.



● ALL ENGINEERS should be familiar with these bronze disks which are used to identify various types of survey stations of the U. S. Coast and Geodetic Survey.

least one station for every 50 square miles of area; and to have permanent points at 1 to 2-mile intervals in metropolitan areas and along major highways and at 3 to 4-mile intervals in rural areas of high land value.

Active field work by the Coast and Geodetic Survey in providing precise vertical control over the United States has been carried on continuously since 1878. Since 1929, the elevations of C&GS bench marks have been based on mean sea level datum as determined at 26 selected tide stations located on the three coasts of the United States. The present plan for leveling is to establish lines spaced six to eight miles apart with permanent bench marks at intervals of one mile or less along the lines. Additional marks are established in each city or town, at airports, weather stations and other points requiring precise elevations.

To date geographic positions in terms of latitude and longitude and in terms of State Plane Coordinates have been determined for about 160,000 horizontal stations. These include all the primary and secondary ground stations as well as stations intersected such as church spires, stacks, water tanks and the like. Approximately 3000 horizontal stations are being added annually.

Bench marks providing elevation above mean sea level are added to the vertical control network at the rate of approximately 8000 monuments per year. There are at present over 418,000 miles of leveling lines in the United States which provide more than 340,000 monumented points of elevation. More than 6,000 requests for triangulation and leveling information are received and processed each year.

Geodetic Survey Methods

Angle observing, base measuring, and leveling are of various degrees of accuracy, depending on the sensitiveness of the instrument used, the methods of observing, the care with which the observations are made, and the refinement of the computations. The average discrepancy along the main arcs of first-order triangulation between computed and measured lengths is about 1 part in 75,000. The average closure of a first-order triangle is not allowed to exceed 1 second. Modified second-order triangulation, which is used to fill the areas between first-order arcs, is observed with first-order instruments and slightly modified procedure

with an average closure of about 1.5 seconds.

Triangulation observations are made with high-grade first-order direction theodolites, usually at night on signal lamps in order to use the best atmospheric conditions. In many areas of the country, triangulation surveys have been greatly expedited by the use of Bilby steel towers. These double towers, formed by two demountable portable tripods, one inside the other, provide a support for the instrument which is completely independent of the outer support for the observing party, signal lamps and other equipment. These towers, ranging in height from 37 to 116 feet, can be erected in a few hours, and can be dismantled, moved and re-erected readily and repeatedly.

Base lines and Laplace azimuths are included in arcs of triangulation at specified intervals, in order to maintain strength in length and orientation. First-order bases are measured with probable errors not exceeding 1:1,000,000 using standardized invar tapes under standard tensions and methods of support. Following extensive field testing a new instrument, the Geodimeter is being used for some base measurements. This instrument utilizes the speed of light in making precise measurements. It is now being used to measure many of the more difficult base lines where rough terrain prohibits or retards the conventional methods. Laplace azimuths are observed with methods to ensure a probable error not exceeding 0.3 second.

The main nationwide network of first-order leveling with lines spaced 60 to 100 miles apart is now complete except for necessary releveling to recover lost bench marks and to bring the vertical control established prior to 1916 up to present standards. Second-order leveling is being established within the first-order loops in order to provide the planned line spacing of 6 to 8 miles.



Geodetic Station Markers

Horizontal and vertical control stations of the Coast and Geodetic Survey are now marked by bronze or brass discs set in concrete mon-

uments, bed rock and permanent structures. The present standard complete marking of a triangulation station consists of a station mark and an underground mark, 3 feet or more below the station mark where practicable; two or more reference marks; and an azimuth mark visible from the ground and usually about one-quarter of a mile from the station. Old marks are of various kinds: staves or bottles buried beneath the surface of the ground; drill holes in stone posts or boulders; bolts in stone posts; and pipes set in concrete. The underground station mark is directly beneath but independent of the surface mark. It is sufficiently deep to be free from ordinary surface disturbances, and should be resorted to only when the upper mark has been disturbed. It occasionally happens that a station is located in a cultivated field and only a sub-surface mark is set well below the reach of cultivation.

The triangulation reference marks are set in protected clearly described spots. Their function is to aid in the recovery of the station mark and to establish the integrity of the station after recovery. The station description will furnish the distances and directions from the station mark.

The azimuth mark monument is set in a convenient location in order to provide a marked line of known azimuth, which the local surveyor can use in establishing a reference meridian for his survey. At many triangulation stations azimuths may also be determined from such objects as church spires, stacks, radio beacons, flag poles, water tanks and similar objects, with care that the object to be used is the same as was intersected during the original work. Generally white wooden 4 by 4 witness posts are set very near both the azimuth and station marks.

The present standard marking of a level bench mark consists of a surface mark disc set in concrete and placed with care as to permanence and vertical stability. In order to expedite the work, leveling lines usually follow highways and railroads. As a matter of routine, leveling connections are made to C&GS triangulation marks, local city datums and to monuments of other surveying organizations when such connections do not involve unwarranted time and expense. A new type of bench mark consisting of the conventional C&GS disc secured to a length of "Copperweld" rod is

(Continued on page 198)

Designing

A SEWAGE PUMPING STATION

J. R. PATTERSON

Chief Engineer,

Floyd G. Browne & Associates,

Consulting Engineers,

Marion, Ohio

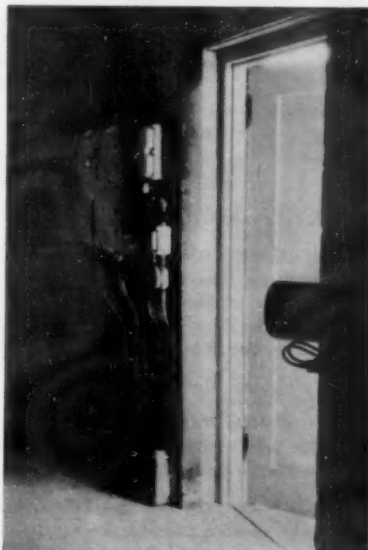
MANY INTERRELATED variable basic design factors are involved in planning sewage pumping stations, and each of the factors must be fully evaluated with respect to present conditions and probable future developments. Lift stations must be adequate to handle existing flows and should be designed so that the pumping capacity may be easily increased for future needs. Obviously, a station that is excessively large for immediate and near-future needs requires a capital investment which cannot be justified and excessive maintenance and operation costs. It is equally obvious that the station must be designed for a reasonable future increase in sewage flows in order to minimize frequent expansion costs and to avoid the danger of surcharging the influent sewer system.

Where it is possible, the station should not be near residential areas because it is a possible source of odors. If this location is unavoidable, the superstructure should harmonize with the architecture of surrounding buildings. Some stations have been designed to resemble high-class residences.

With main sewers located in the valleys, pumping stations are built in the valleys also. Preferably they should be located near a stream or channel into which an overflow pipe can discharge as an emergency outlet for the inflowing sewage in case of power failure. Such an overflow is generally higher than the incoming sewer, in which case the influent sewer is surcharged when the overflow is in operation. This may cause flooding of basements and the resulting damage may necessitate the use of "dual-drive" pumps driven by either standby engines directly or through electric motors. The fre-



● **LOOKING down into dry well: Twin vertical pedestal mounted sewage pumps with necessary control valves.**



● **ENTRANCE doorway, showing pump motor and station lighting controls; also a dual-circuit float switch control.**

quency and duration of electric power failure will be an important factor in the selection. In any case, the emergency overflow should be provided as unforeseen wet weather flow conditions may exceed the capacity of the pumps. Adequate room for access roadways for construction and maintenance purposes should also be considered in choosing a site.

Two Basic Types

There are two basic types of pumping stations—the wet-pit type and the dry-pit type. The wet-pit type is used for small quantities of sewage and consists of a single pit into which the sewage flows and in which vertical type pumps are submerged. A superstructure is sometimes provided. The pumps must be withdrawn for repairs and, consequently, such a station should not be used except for small sewage flow where the cost of the dry-pit type cannot be justified. The dry-pit type consists of a wet well into which the sewage flows through screening and possibly metering devices and from which the pumps take suction. An adjacent dry pit contains the pumps, valves, and controls. A superstructure is usually provided. In such a station the equipment is readily accessible for operation and repair. The metering equipment may be located in the dry-pit on the discharge side of the pumps. The capacity of the dry-pit type station is limited only by the size of the pumps installed.

If pneumatic ejectors are used, the latter wet well may be omitted, and the dry pit contains the ejector pot, compressor, and controls. Sewage enters the ejector pot and, through the action of check valves in the inlet and discharge lines, is forced out by air pressure. This type is suitable for small stations but the efficiency is low—generally somewhat under twenty percent. If screening is necessary it must be

done in an adjacent wet well. However, little maintenance is required; the ejector will pass larger solids than comparable small sewage pumps, and screening is not always required.

In any of the above types of station the wet well or ejector chamber serves to store the incoming sewage, when the rate of inflow is less than the pumping rate, so that the constant speed pumps will not be required to start and stop frequently.

The basic approach to the design of the station may be described as follows:

(1) A study of the areas to be served by the station: population density and area, present total population, future total population;

(2) A study of the sewerage system to be served by the station: separate or combined; quantity of wet weather flow from infiltration and storm water cross connections; lift station sites available; reliability of power source;

(3) Development of industrial and commercial areas;

(4) Estimate of sewage to be pumped: domestic, commercial, industrial wastes, infiltration and storm water, average daily flow of each component, maximum hourly flow of each, and minimum hourly flow of each;

(5) Type of pumping station and equipment needed: wet well or dry-pit type, number and sizes of pumps and prime movers, screening and metering equipment, size of wet well for storage and overflow, grit removal facilities if necessary, heating and ventilating equipment, architectural treatment of superstructures, access roadways and parking area, estimate of power and operation costs.

Illustrative Example

The design of a lift station can best be illustrated by an example of an actual pumping problem and its solution. In a small northeastern Ohio city, a pumping station is required to lift the sewage from a new intercepting sewer into a new gravity sewer. The intercepting sewer will relieve flooding in the existing main collecting sewer. The existing sewers are part of a separate sanitary system of lines laid many years ago. There are undoubtedly some unknown storm water connections and considerable infiltration through defective pipe joints; however, total infiltration is not considered unusually excessive. The pumping station is to be designed for a period of 25 years in the future. The tributary area is

made up of moderate class residential, light industrial and commercial developments; and is expected to expand in the future with the same general character. Approximately 300 acres are undeveloped at the present time.

The site of the station is not the most desirable from a design and construction standpoint, but due to the proximity of railroad and industrial properties, it is the only site available at reasonable cost and without litigation of doubtful outcome. It is approximately 900 feet from a normally dry ditch which might serve as an overflow outlet. The site borders on a public street where all existing sewers are located and where water and electric power are available.

The basic design data are itemized as follows: (1)

Area in acres	Present	Future
Domestic	470	753
Commercial	31	42
Industrial	139	369
Undeveloped	224	—
Total Area, acres	864	1,164
Population:		
Present time	470 @ 10 per acre	
Future	753 @ 10 per acre	

(2) The tributary sewer system includes a new intercepting sewer and a new main sewer in addition to existing separate sewer systems,

with some unknown storm water connections to old system. Several known cross connections are to be eliminated. The condition of the old sewers is fair to good, and they are relatively shallow. Infiltration is not usually excessive. Soil reportedly consists of sand, gravel and clay. Test borings have not been made. The new sewers are to be built under specified limits of exfiltration under test pressure. Infiltration is estimated at 0.001 mgd. per acre of tributary area average rate. The site selected is the only one available at justifiable cost, but has good access from public thoroughfares. Water, gas, and electric power are available. The source of power is reliable, and power is available from three primary circuits equipped with the necessary switching facilities. The use of dual-drive pumps is not economically justified.

(3) The tributary area contains some commercial and light industrial areas as well as residential and undeveloped areas which are expected to develop in the future into an area of the same general character.

(4) The flow data are computed as shown in the tabulation below:

(5) The pumping station is to be the dry-pit type. Vertical, non-clog sewage pumps are to be located in the dry-pit, with shafts to be

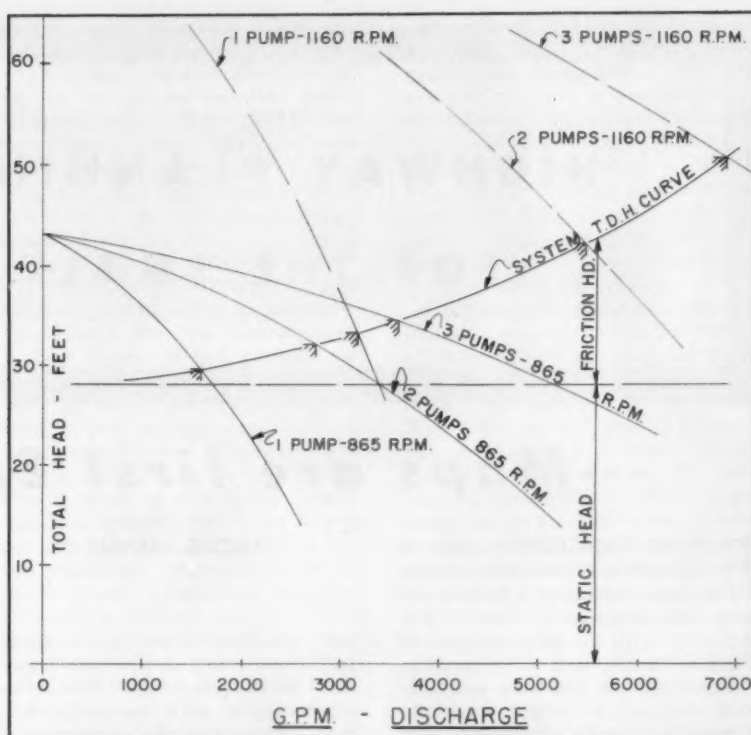
Tabulation of Flow Rates, Present and Future

	Present mgd.	Future mgd.
AVERAGE RATE OF FLOW:		
Domestic—4700 persons @ 100 gcd	0.47	
7530 persons @ 100 gcd		0.75
Commercial—31 acres @ 0.02 mgad	0.62	
42 acres @ 0.02 mgad		0.84
Industrial—139 acres @ 0.01	1.39	
369 acres @ 0.01		3.69
Infiltration—864 acres @ 0.001 mgad	0.86	
1164 acres @ 0.001 mgad		1.16
Total average flow	3.34	6.44
PEAK RATE OF FLOW:		
Domestic flow x 2.5	1.18	1.87
Commercial flow x 2.0	1.24	1.68
Industrial flow x 1.5	2.08	5.54
Infiltration flow	0.86	1.16
Total peak flow	5.36	10.25
MINIMUM RATE OF FLOW:		
Use 0.40 of average flow without infiltration		
Minimum flow	1.00	2.12
SUMMARY OF FLOW TO THE STATION:		
Total sewage pumped (average)	3.34	6.44
Minimum rate of flow	1.00	2.12
Maximum hourly rate of flow	5.36	10.25

extended up to the floor at ground level. The wet well is to be equipped with a comminutor for grinding screenings and with a hand-cleaned by-pass screen. Since grit is not a vital factor and since the influent sewer is over 16 ft. deep, no grit removal facilities will be provided. Ample fillets will be provided to conduct grit to the pump suction. Such grit that is passed will then be received in the grit removal tank at the sewage treatment plant. The dry pit will be 30 ft. by 17 ft. 4 in. and 25 ft. deep.

The sewage pumps will be selected to take present flows which are believed to be estimated liberally enough to cover conditions for the next 5 to 10 years; one standby pump is provided as a factor of safety. Large, slow-speed pumps will be selected so that in the future, when additional capacity is needed, new impellers and higher speed motors can be installed in order to provide higher pumping rates. Four 8-in. by 8-in. vertical, open-shaft, non-clog, water sealed, centrifugal sewage pumps rated at 1200 gpm at 34 feet TDH will be selected, each driven by a vertical, hollow shaft 15 hp. motor at 865 rpm. Substitution of new impellers and 40 hp. motors at 1160 rpm will increase pumping capacity in the future to 2300 gpm each at 51 ft. TDH which will take care of a peak flow rate of practically 10 mgd with three pumps operating.

Figure 1 is a graphic picture of the performance of 3 sewage pumps operating in parallel, discharging through a common force main. The pump performance curves are plotted with the total dynamic head (TDH) curve for the suction and discharge piping. When pumps are operated in parallel the discharges (gpm) for each pump are additive for a given head (TDH). Consequently, for a given head, the discharges for any number of pumps can be added and plotted as in Figure 1. As the flow of liquid through the pump and pipe system increases, the friction head increases parabolically as shown by the TDH curve which is made up of friction and static head. Therefore, the intersection of any pump curve with the system TDH curve indicates the delivery of the pump or pumps in gpm for this particular point on the TDH curve. Thus it is seen that one pump at 865 rpm will deliver 1600 gpm and 3 pumps will deliver 3600 gpm. One 1160 rpm pump will deliver 3200 gpm and 3 pumps will deliver 6900 gpm. Effi-



● PUMP CURVES, Figure 1, show performance of three pumps operating in parallel and discharging through a common force main, plotted for both 865 and 1160 rpm.

ciencies will range from 70 to 79 percent depending on operating head. The pumps selected will pass 3-in. solids.

The pump motor windings will have special impregnation for protection against wet atmospheric conditions. They will be 220/440-volt, three-phase, 60-cycle, squirrel cage induction type.

Size 3 combination circuit breaker-magnetic starters will be supplied which are large enough for the 40 hp motors. Circuit breakers with interchangeable trip units will permit readily providing proper short circuit protection for both the 15 hp and 40 hp motors.

Conduit and wiring will be installed on the basis of the 40 hp requirement. The starting and stopping will be controlled by a compressed air system and "bubbler tubes" in the wet well, starting the pumps in succession on rising water levels in the wet well. Stopping the pumps will occur in reverse order on falling water levels as sewage inflow decreases. Transfer switching will be provided so that pumps used for low flows may be interchanged and the wear distributed over all four pumps.

Gate valves on the main piping will be of the wedge disc, iron body, bronze-mounted, flanged, non-rising stem type. The check valves on

sewage pump discharge lines are swing-disc iron body type, bronze-mounted with weight or spring loading to provide quick closure when pumps stop, thus minimizing water hammer. They are mounted in a horizontal position.

The screening devices in the wet well will consist of an oscillating type of motor-driven comminutor and a sloping, manually cleaned, by-pass bar screen. The bar screen channel will parallel the comminutor channel, with a common entrance flume serving both channels so that by means of stop gates the incoming sewage can be conducted through either or both. The top of the stop-gate in the bar screen channel will be set at such an elevation that sewage in excess of the capacity of the comminutor will overflow into the bar screen channel. In the future a second comminutor can be installed in place of the bar screen.

Selection of the size of comminutor is made from hydraulic performance charts published by the manufacturers, on the basis of proper submergence of the cutters for maximum, average and minimum rates of sewage flow through the screen and cutters. At maximum flow the screen and cutters must not be submerged beyond a
(Continued on page 187)

HIGHWAY PLANNING FOR THE SMALL TOWN

---Maps are first Essentials

TRAFFIC CONGESTION used to be the exclusive headache of large cities, and a variety of nostrums has been compounded for their relief. But even with the full resources of Federal, State, and City governments, progress has been painfully slow, due to the complex problems of planning, design and construction in heavily built-up areas.

The smaller communities, which have to fend for themselves, are in the position of "too light for heavy work and too heavy for light work." Their traffic problems are dwarfed by the congestion in the large metropolitan centers. The small-town engineering staff usually totals one

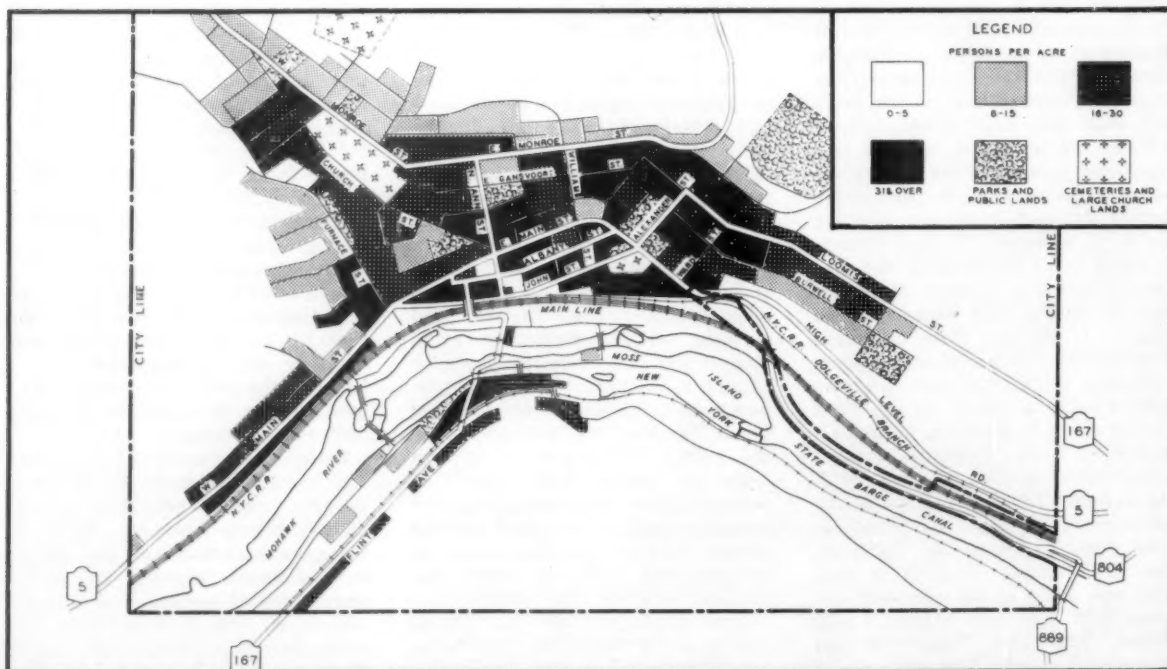
JACOB MENDE

man, who handles both public works and engineering. Assistants, if any, are technicians only. Most disheartening of all is the public attitude—because traffic congestion is not presently intolerable, the small-town public is apathetic. The future is a long way off, and highway planning is something they do in big cities.

Engineers deal in facts. Accordingly, the first step in highway planning, as in any other engineering project, is to get the hard facts on

which to base decisions. Despite the sneers of designers and construction men, highway planning is not for "long-haired dreamers." It is engineering technique requiring the utmost in professional skills. It is the best investment a community can make and a necessary item in its engineering budget.

Since the primary purpose of highways is to take people where they want to go, it is essential to know all about the community—what distinguishes it from any other community? How does it look to an outsider? To engineers, the answers to these and similar questions are best portrayed on maps.



● POPULATION density map: How many are there and where do they live? Map shows high traffic and sparsely settled areas.

Every city and village has an official map. But all too few have maps suitable for planning a highway system. If pressed, the official family would indignantly say, "We have a map," like the man who was given a book for a birthday present and disgustedly said, "But I already have a book." Functional maps are engineers' tools and are as specialized as a mechanic's tool kit.

Basic Map Series

There are two basic map series which are essential to the planning of a highway system in built-up areas. The first deals with people—your neighbors and mine. It is designed to answer the question, "How many are there and where do they live?" Whether the population is 1500 or 150,000, a population density map will show which areas are most intensively developed. The use of this type of map is twofold: First, it shows the areas which generate the heaviest traffic volumes and therefore require more traffic service; second, it shows the vacant or sparsely settled areas which not only require less traffic service but also are suitable for locating new routes if these are required.

Population maps may be prepared by one or a combination of methods, depending on availability of census and other data. If Sanborn maps are available, the population can be easily estimated for each desired section by dividing the total popula-

tion by the number of dwelling units to obtain an average population per dwelling unit. Another simple method is to proportion the voting registration by districts to the total population. In determining the population density for each section, vacant land, of course, is excluded to arrive at an accurate figure for the areas actually in use.

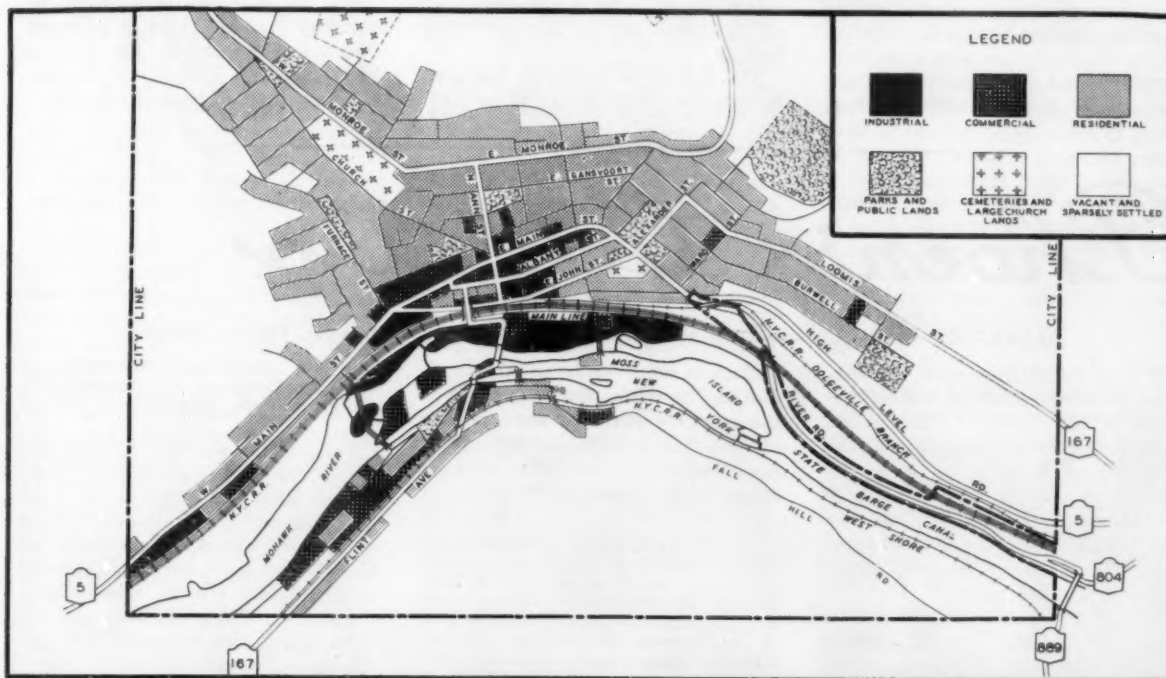
Depending on the size of the community, two or more ranges of density will be necessary on a population density map. The lowest group is best shown as 0-5 persons per acre, because this range includes both the vacant and sparsely settled land, which averages only one or two houses per acre. The next group of 6-15 per acre shows the medium density areas of one-family homes, usually averaging two to six houses per acre. Cities in the 25,000 to 50,000 population range will have the 16-30 group comprising two and three-story houses and the 31-60 group for multiple dwellings. Very large cities will of course have much greater densities in apartment areas.

The second map series shows where the people in the community go to work, to shop and to relax. Land use maps therefore indicate which areas are used (not zoned) for industrial, commercial, park, recreational, and other purposes. In planning highway systems, it is very important to distinguish between commerce and industry on land use maps.

An industrial plant processes raw material or semi-finished goods, usually ending up with a completed product, whereas a commercial establishment carries on retail or wholesale trade, service, storage, etc. Trafficwise, the industry usually has a heavy morning and afternoon peak load of employees, with light traffic during the day, but commercial areas generate considerable traffic throughout the day.

Preparing the two basic series of planning maps is not so formidable a job as it might sound to those who hold the purse strings. In New York State, the Department of Public Works Bureau of Highway Planning has prepared population density and land use maps for 55 cities ranging from 8,000 to 500,000 population as part of its urban arterial program. Some 75 percent of these maps were made from the field work of two-man crews who started out with nothing but city maps showing streets.

By simply driving around the city, the land use was recorded on the work maps. Vacant areas were also indicated, thus providing a portion of the information for the population density map. Two men averaged a city per day in the field for cities up to 30,000 population. A by-product of this work was the correction of the street maps. Aerial photographs, of course, were tremendous helps in making up the basic map series.



● LAND use map shows where people in the community go to work, to shop and to relax—all are important in highway planning.

What scale should the basic maps be drawn to? Contrary to popular belief, the smaller the map the more useful it will be in planning the highway system. Whereas a 50' = 1" scale is useful for highway design and a 20' = 1" scale is common for bridge or other detailed studies, the benefits of the population density and land use studies will be lost in detailed drawings. An area of 4-10 square miles will show to best advantage at a scale of 500-1000 feet to the inch. This reduction will bring the highlights of the area into sharp focus. When actual design is begun, the conventional scale drawings should be utilized.

When the two basic map series have been prepared, the highway planner has a good start on the problem, although it would be hard to convince the motorists tied up in the Main Street traffic jam that this is so. They want wider streets, not maps. But highways mean people, and the engineer has put down in black and white all the pertinent facts about the people in his community, with one exception. Communities grow. Today's school-boy or school-girl is to-morrow's horn-blowing taxpayer, who joins the crowd yelling, "Do something."

Highway planning, to live up to its name, must provide the highway of to-morrow for the community of to-morrow. This phase of the study requires not a crystal ball, as critics claim, but good engineering judgment, imagination, and the ability to piece together bits of information gleaned from realtors, bankers, businessmen and industrialists. People will still be going to work, to shop,

to relax—but there will be more of them; the highway of to-morrow will still be required to take them where they want to go. Horns will probably be louder.

In planning for the future, the first step will be to determine whether to make a 20 or a 30-year forecast. If highways only are involved in the planning, a 20-year period is sufficient, based on the average life expectancy of a highway before reconstruction or major resurfacing is needed. Where bridges are involved, a 30-year forecast is desirable. Estimates beyond this period can only be compared to the farmer's comment when he first saw a giraffe at the zoo: "There ain't no such animal."

There are as many methods of forecasting population increases as there are statisticians and economists, but engineers can play the guessing game with an ace in the hole—engineering judgment. The population trend over the past 40 to 50 years should be plotted first to review what has already happened. This is history, but significant. The increases or decreases are not just points on a curve, but milestones on the development of the area.

People take root where they earn their daily bread and enjoy living. When earnings cease or living conditions become undesirable, people migrate. There are, of course, residential communities near large cities, where the population largely commutes to work, and the economy of the large city is the governing factor.

The future economy of the area is thus the prime factor to be con-

sidered in making the 20 or 30-year forecast. Informed guesses can be obtained from the banks, industrialists, and others who are interested in the area. Will the factories expand? Jobs mean people. People mean traffic. Will a new shopping center be built? A new housing development? The utility companies make forecasts to plan their expansion of facilities, as do the school districts.

Having gathered all the available data and estimates, the highway planner prepares forecast maps for population density and land use. This map series will show the community of 20 or 30 years hence. Existing vacant areas may be built up to 6-15 persons per acre, and existing areas of 16-30 density may be down to 0-5 to provide for the new factory addition, shopping center, or other future land use.

If the city or village is properly zoned, the forecasts have already been made. Proper zoning requires setting aside sufficient land for each type of usage to maintain an expanded economy while still providing a desirable living climate for the estimated population. It is desirable for the highway planner, however, to check with the zoning board to make sure the map is realistically based on a balanced economy, rather than someone's wishful thinking.

With the forecast maps in hand, the village or city engineer has taken the first step in planning his highway system. There is no magic formula. It is a step by step process, like building a bridge; the foundation is people, instead of concrete.

Phoenix Lights Up

ALBERT R. PIERCE, Administrative Assistant To the Public Works Director, Phoenix, Arizona

IN THE PAST five years, Phoenix has become one of the best lighted cities in the nation. This results from a long-range lighting program designed to keep pace with the growth of the City. Phoenix is now served with a modern lighting system which meets the standards of the National Association of Illumination Engineers.

In 1951, Phoenix entered into a contract with the Arizona Public Service Company to provide 5,494 new street lights over a 4-year period. The initial number of in-

stallations were made as stipulated and in line with provisions made in the contract, the program has been extended to include the lighting of newly-annexed areas. The contract contains the following provision:

"IT IS FURTHER UNDERSTOOD AND AGREED that parties contemplate that the City may desire additional facilities either in areas hereafter annexed to the City or by way of improvement to existing facilities. Company agrees, upon request, to meet with City to discuss such additional facilities, and upon agreement with respect thereto between Company and

City, and upon proper authorization by the City, Company will proceed diligently with the installation of them."

Prior to the start of the program, the entire lighting system comprised only 1,794 lights. This inadequate and rigidly limited system served a population estimated at 111,100 and an area of 17.2 square miles. Today modern street lighting reaches into every corner of the City, which has expanded tremendously in the past five years. Phoenix now has an estimated population of 171,794 and the area of the

City limits has been increased to 36,311 square miles.

A total of 6,879 new lighting units have been installed as of November, 1956. They have been designed so as to provide sufficient lighting on the arterials as well as throughout the residential areas. Included in the over-all total are 3,047 lights installed on 47.5 miles of arterial streets, 3,761 residential installations and 71 alley lights.

The cost to the City for the new system has ranged from \$96,324 for the first fiscal year of the program to \$270,155 for the fiscal year ending June 30, 1956. In the current fiscal year budget, \$347,440 is earmarked for the street lighting program. Included in this appropriation is the charge for power as well as the cost of leasing the lighting system. In return, the Arizona Public Service Company has invested well over a million dollars of their own funds to install, maintain and operate the system. The City is billed on the basis of the type and number of lamps and standards installed.

At the time the contract was negotiated with the Company, the administration inserted a provision which allows for purchase by the City of all or part of the system if so desired. It provides that the City will purchase at a price set by an independent appraisal.

As a result of this program, Phoenix has one of the nation's finest street lighting systems in return for rates which are proportionately one of the lowest in the country for cities with comparable lighting systems. The rate structure is flexible enough to cover any combination of standard and fixture in either overhead or underground construction.

Incandescent type lamps were primarily installed since the program was started but over the past two years the trend has been towards the use of mercury-vapor

lighting, especially on main and secondary arterial streets. Priority of installation is based on studies of traffic flow and accident frequency conducted by the Arizona State Highway Department, the City's Division of Traffic Engineering and the Police Department. A street light installation schedule is submitted to the Company at the beginning of each fiscal year.

All the business and arterial streets in the downtown area have been lighted with 15,000 lumen lamps installed on 35-foot steel poles spaced about 60 feet apart. Intersections on these streets have four lighting standards. Secondary business and arterial streets are lighted by using 10,000 lumen lamps mounted on 35-foot steel standards spaced at 75-foot intervals. In some instances, wooden poles are used on secondary business and arterial streets. In residential areas lighting is furnished by 35-foot wooden poles with 8-foot brackets and top mounted luminaries with 6,000 lumen lamps. Lights are installed at each intersection in the residential area while blocks longer than 300 feet have one or more lights in the middle of the block. Mounting height for the incandescent lamps is 28 feet. For mercury-vapor installations, 38-foot steel standards are used which are spaced about 110 feet apart. Mounting height for the mercury-vapor lamps is 32 feet.

All lamps are furnished by General Electric. The majority of the incandescent luminaries are obtain-

ed from the Line Material Co., while a few have been supplied by Joslyn Mfg. Co. and Westinghouse. Mercury-vapor luminaires have been furnished by General Electric. All the steel standards are supplied by the Utilities Supply Co.

Approximate cost for incandescent type lighting installations is \$220 with wooden poles and \$300 with steel standards. Mercury-vapor lighting on steel standards costs approximately \$380.

The lighting units are designed to provide the following candle power: Primary business and arterial streets, 1-foot-candle average maintained; intersections, 2½ candles; secondary business and arterial streets, 0.75 foot-candle; and residential areas 0.2 to 0.4 foot-candle.

Plans for the current fiscal year call for the installation of approximately 1,800 new lighting units. Included in this total are 1,000 residential units.

Commenting on the success of the program, Phoenix City Manager Ray W. Wilson said: "Street lighting is one municipal service that touches everybody, and one that is appreciated by everybody. It is important not only from the standpoint of the fine appearance it gives to the City, but also from the point of reducing motor vehicle and pedestrian accidents. The reduction of crime during the hours of the darkness is another important factor. Many cities have reduced night crime by more than one-half through the installation of modern lighting."



● PHOENIX is now a well-lighted city. This shows a main business section.

● RESIDENTIAL section has wood poles and incandescent luminaires.



● INCANDESCENT luminaire and 35-foot steel pole in business area.



● MERCURY-VAPOR luminaires are used in some downtown installations.



FACTORS INFLUENCING THE CHOICE OF

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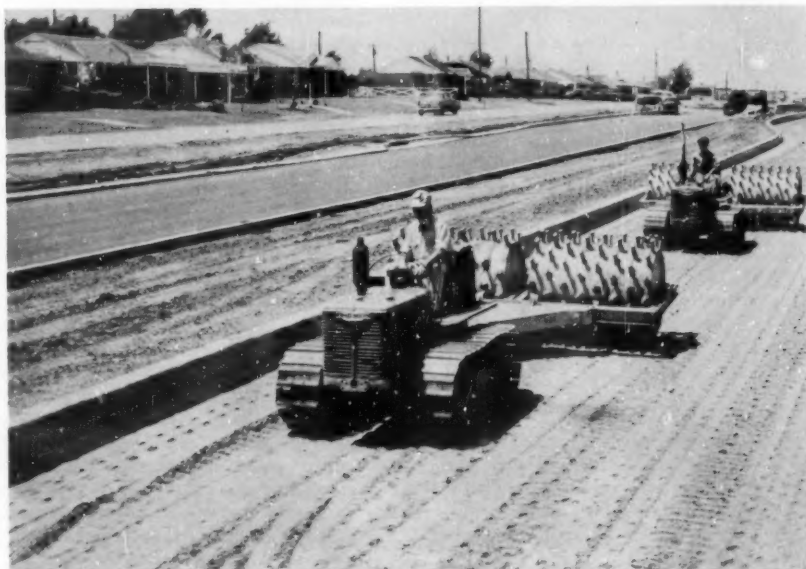
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STRUCTURAL REQUIREMENTS lead to construction specifications. These are important in any consideration of compaction. Establishing the specifications is the responsibility of the engineers who design the structure. Adherence to the specifications while producing the most economical job, is the problem in construction.

In the final analysis, the governing factor for both design and construction is one of economics. It is a mistake for a designer to require more compaction than is needed. Unfortunately, the technique for establishing the desirable density is not too accurately defined. In principle, the structure must be stable, and the costs that result from too little compactive effort must be compared with the costs for greater compaction. The tendency in design is to require as much compaction as the available equipment can produce. This is done to obtain maximum stability and represents an assumption that the added costs are justified or that the greatest densities possible are required from a strength, settlement, or permeability viewpoint.

A desirable factor in construction is the freedom to accomplish the compaction in the most economical manner but within the limits of specifications. There are many ways by which the costs of compaction can be influenced and the type of equipment to be used is one of the important ones. Since equipment is being constantly remodeled and developed, repeated evaluations of compaction equipment are necessary if costs are to be kept at a minimum. The following discussion attempts to clarify and simplify the relative importance of various fac-



Courtesy International Harvester Co.

● **SHEEPSFOOT** rollers drawn by crawler tractors provide compaction on a two-mile section of a new bypass on US Route 66 in the northwest section of Oklahoma City.

tors influencing equipment selection; to provide the principles that are involved with compaction; and to indicate how one can best judge which of the several types of equipment is most likely to be effective in a given situation.

The following factors will influence the compaction techniques through their effect on the soil density that can be achieved under any given condition:

- 1.) Construction specifications;
- 2.) type of soil to be compacted;
- 3.) soil moisture content during compaction;
- 4.) depth of soil layers;
- 5.) types of compaction equipment;
- 6.) number of passes made by the compaction equipment; and
- 7.) embankment foundation conditions.

1. **Construction specifications.** Highway specifications will frequently control many phases of compaction. The principal reason for controlling density of embankments is to reduce settlement to a minimum. Compaction cannot prevent settlement which arises due to poor foundations, but it will control the

amount which the embankment material itself will consolidate. Uniform settling of the embankment surface can produce damage but to be particularly detrimental to the highway, the settlement must be "differential"; that is, greater at one spot than another. These problems can develop due to "differential" or non-uniform soil density. Unfortunately, estimates of such settlement are difficult to make. Procedures which reduce this type of pavement damage, and also permit less expensive compactive methods, consist of delaying the placing of the final pavement surface on the completed embankment. This is normally done in one of the following ways: one or two years with no surface, completion of the embankments ahead of other phases, or a temporary surface that will serve the traffic.

Thus, uniformity of soil density is desirable in order to eliminate all settlement. To avoid differential settlement, densities at a given grade elevation must be compara-

COMPACTION EQUIPMENT



ble. For example, if a 12-inch lift is compacted so that the density of the upper 6-inches is uniformly 110 lbs. per cu. ft. while the lower 7-inches is uniformly 105 lbs. per cu. ft., no "differential" settlement should take place. Some uniform settlement may result if the 105 lbs. per cu. ft. is too low. For earth dams, uniformity of soil density at all levels is highly desirable due to seepage factors.

In many cases, specifications require high densities in order to prevent slides or slope failures. It is an established fact that for a clay-type soil the safe height of an embankment with a given side-slope is determined by the shearing strength of the soil. Since shearing strength generally increases with density, compacted soils will permit higher embankments for the same side slope. In mountainous terrain where side-hill embankments are common, high shearing strengths are essential if landslides are to be avoided.

The influence of these considerations on the design engineer leads him to a decision on the amount of

control that must be placed on construction. There has been a tendency in the past for specifications to restrict the method and equipment to assure obtaining the best possible compaction. During recent years, efforts to reduce costs have led more and more engineers to favor specifications which give maximum latitude in construction methods. This normally results in specifying only the final density.

For circumstances where the specifications completely control compaction, the following discussion will be of little help. However, if some latitude exists, or if new or revised specifications are under consideration, several influences can contribute to the decision as to the type of equipment to be used.

2. *Type of soil to be compacted.* The type of soil will influence compaction technique due to different properties of granular and cohesive materials. Many soils are intermediate between granular and cohesive, and will generally be treated as cohesive soils insofar as compaction is concerned. If at least 75 percent of the soil particles are sand-size or larger, the material is generally considered granular. If only 25 percent are this large, the material will generally behave as a cohesive material. Intermediate soils will vary between granular and cohesive-type behavior.

For many years, vibration has been recognized as the best method to densify granular soils. However, efficient equipment, capable of large production rates has not been developed to the point where it will compete economically with other compaction methods. Vibration combined with compression represents the most satisfactory method currently available for compacting granular materials.

Another problem unique to granular soils is concerned with how to specify the degree of compaction. Many specifications do not include a minimum density for sandy or gravelly materials since a "maximum" density cannot be obtained

as determined by ASTM Test D698-42T. In recent years, use has been made of Relative Density, which is the ratio of the difference between the maximum and the desired void ratios and the difference between the maximum and the minimum void ratios.

For fine-grained, clay-type soils, static or dynamic compression will produce the best compaction. Vibration is not likely to be of too much assistance. Thinner layers are normally required than for granular materials. Rollers that apply compression directly to the surface of the loose material tend to produce higher densities in the upper portion of the layer. For highway embankments, this does not present a problem unless the density in the lower part of the layer is not adequate. This latter contingency must be considered whenever surface rolling is used on fine grained soils. In order to obtain completely uniform compacted cohesive soils, sheepfoot rollers are recommended.

Thus, granular, non-cohesive materials can be most efficiently compacted with a compressive action combined with a vibratory or dynamic action if possible. On the other hand, fine-grained, cohesive soils need a tamping-type roller for complete uniformity of density, or a compressive type of load if absolute uniformity of soil density in a vertical direction is not required.

3. *Soil Moisture Content during Compaction.* The water content of cohesive soils at the time of compaction absolutely controls the density that can be obtained by a given piece of equipment. The so-called Proctor or Moisture-Density Test (ASTM-D698-42T) shows clearly that the density that is developed under specific compactive effort reaches a maximum value at a moisture content known as the "optimum." If a lesser or greater moisture content is present, a lower density will result. While this is true for cohesive soils, the phenomenon does not hold for granular materials.

If the compactive effort is increased, (for example, by increasing the roller weight) higher densities can be achieved with less moisture present. Conversely if less compactive energy (lighter roller) is used, then the "maximum density" can not be achieved at any moisture content. The laboratory compaction tests are based on certain assumptions as to the type of equipment available for use. Field densities are not difficult to achieve with standard equipment unless sufficient care is not taken to control (1) the moisture, or (2) the relationship between roller weight and the foundation conditions or an increased layer thickness.

Therefore, care must be taken to obtain the proper moisture content in cohesive soils during compaction with standard equipment. Where greater than the standard compactive energy is used, considerations of roller weight, supporting foundations, and layer thickness, may lead to less expensive compaction due to a reduced optimum moisture content. For granular materials, moisture is not critical.

4. *Depth of Soil Layer.* The loose depth of the layer being compacted is also a controlling factor. Without a doubt, the thinner the layer, the more efficient is the compaction insofar as energy input is concerned with the results achieved. However, increased demands for more economical construction has resulted in greater and greater layer thickness. To accomplish these savings, larger rubber-tired rollers have been built. The trend is toward the use of more pneumatic-tired rollers. Depths as great as 24 inches have been satisfactorily compacted. Data are inclusive as to how much "differential" density (from top to bottom of the layer) is developed in such cases. A serious limitation on the thickness of the layer results where there is insufficient water in the soil to be compacted. Efficient mixing equipment is not available for layer depths in excess of 12 to 15 inches. The "efficiency" is relative, of course, and refers to the economics of mixing water into a 24-inch layer as compared to two 12-inch lifts.

As mentioned in the preceding section, the laboratory maximum density assumes the application of a standard amount of compactive energy. The thickness of the layer affects the amount of compression applied to the lower portions of that layer. The use of heavier rollers can provide an adequate compressive force for a layer thickness



Courtesy Ohio Dep't. of Highways
● THREE-WHEEL rollers are most frequently used on earth work for final subgrade compaction, as shown here on Ohio State Route 125. Contractors were Vest & Bartell

greater than that assumed for the "standard." The possibilities of greater densities at the top of the layer is still a problem, however, when rolling is applied directly to the layer surface of cohesive materials.

5. *Type of Compaction Equipment.* On the basis of principle employed, compaction equipment can be divided into surface rollers, tamping rollers, and vibratory compactors. Surface rollers include smooth wheel, pneumatic tire, super-compactors and construction equipment. All of these provide a compressive force to the surface of the loose material and depend upon these pressures for their compactive influence. Construction equipment is included due to the fact that heavy dozers and hauling equipment provide vibratory and compressive forces that can produce excellent results if properly routed over the construction.

Tamping rollers penetrate beneath the surface of the loose material, compacting from the bottom up. For sheepfoot rollers, the penetration decreases after a number of passes due to the build-up in bearing capacity of the soil. In turn, fewer feet are in contact at a given instant which increases the pressure per foot, further densifying the soil. For cohesive soils, the sheepfoot will ultimately "walk-out"; that is, the feet will not penetrate more than an inch into the soil.

Vibratory compactors are not used extensively within the embankments proper, although more and more such equipment is being seen in pavement base construction. Vibroflotation, a relatively

new technique, may be feasible for compacting deep layers of relatively clean sand in the foundations of the embankment.

In addition to the principle employed for compaction, important variables inherent with equipment types are the total weight, pressures, and rate of compaction. Most compaction equipment offers some flexibility in weight and pressure, and the selection of proper values is dependent upon soil type, layer thickness, number of passes, and moisture content. The interrelation between these will be discussed later. The speed or rate of compaction is an economic consideration and must be considered in conjunction with other cost variables. The actual speed can be partially affected by the layer thickness and soil type, but is largely constant for a given compactor.

Thus, surface rollers are more satisfactory for granular-type materials. For highway embankment construction, however, surface rollers can produce adequate results with cohesive soils under proper conditions of layer thickness, moisture content, and pressure. Tamping rollers will produce a more uniform soil density with cohesive soils, but are of no value for compacting granular material.

6. *Number of Passes Made by the Compaction Equipment.* The number of passes required to produce a given density becomes a major factor in economical analysis of compaction costs. There is some variation in the definition of "passes." Most organizations refer to a "pass" as being one single application of a given roller and that is the defini-

tion used throughout this article. To a few groups, passes will represent one round-trip of a roller.

By varying the weight or pressure applied by the roller and by changing the layer thickness, there is a point beyond which additional coverage will develop little or no increase in density. This optimum number of passes varies with soils, type of equipment, and moisture content. Since in most instances a specified density is desired, it may be more practical to use a heavier than normal roller (and perhaps a relatively thin layer) so as to produce the density in the smallest possible number of passes. In such instances, it might be possible for the density to be increased appreciably by more coverages, but it would not be required. In general the number of passes that will achieve additional, significant density will range between four and ten.

Research organizations and manufacturers will frequently provide data as to the loose depth of soil that can be compacted efficiently, along with the number of passes that are required to obtain the maximum density. In summary, for equal operating speeds, the thicker the lift that can be satisfactorily compacted with the fewest number of passes, the more economical the compactor, subject to the limitations of uniformity of density.

7. Embankment Foundation Conditions. The foundation conditions can have a marked effect on the density achieved. If the foundation soil is weak, the entire mass will deform either plastically or elastically under the compaction loads. A great amount of elastic rebound is possible under the relatively rapid load and release conditions imposed by compactors. This leads to continued excessive deflections and the soil mass will not "stand still" for densification. Under such conditions, the maximum density may not be possible to achieve. A light-weight roller to initiate the compaction will frequently permit the development of higher densities. Generally, the condition should disappear after three to five feet of fill height has been constructed. This type of problem should not arise frequently on highway projects, because design engineers attempt to eliminate these materials. Weak foundations will lead to slides or to adverse settlement that originates beneath the embankment.

The development of compaction equipment has been as spectacular as has been the improvement in

other types of earthwork items. The trend is toward heavier and heavier rollers, with super compactors as large as 200 tons having been used on some large-scale operations. In addition, special adaptations have been made in conventional rollers in order to make the equipment more versatile.

Types of Equipment

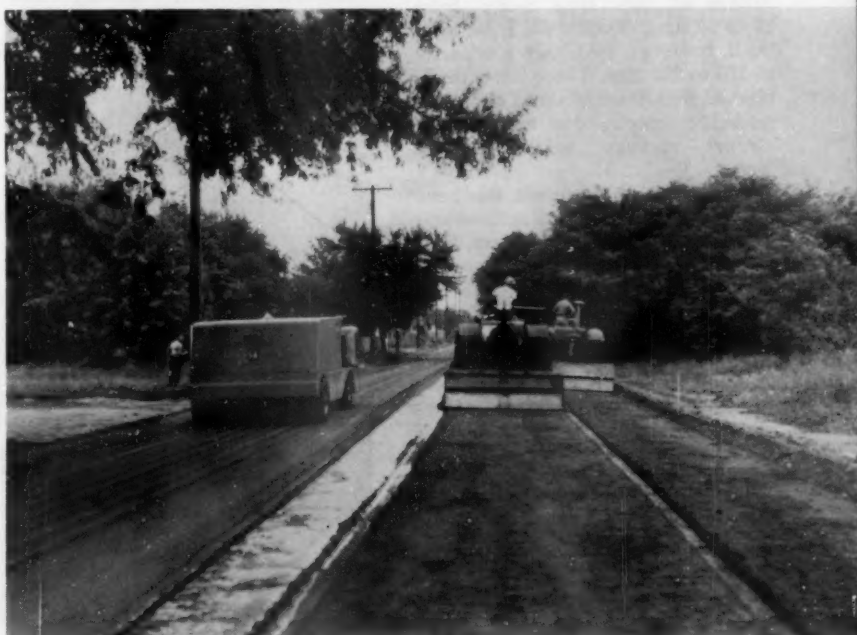
The following discussion of the kind of equipment that is available considers only the more conventional types of compactors. The newer adaptations can be considered in the same light as those that are included.

Smooth wheel rollers include standard three-wheel and two-and three-wheel tandems for embankment compaction. In the United States, these types are being used less and less for soil compaction. They are not too practical for use on highway embankments due in part to the limited total weight, thickness of lifts, low operating speeds, and difficulty in safe operation at the edge of high fills. However, tests have shown that the average density achieved in an 8-inch lift will compare favorably with that obtained by other equipment. A serious limitation for their use on large-scale earthwork is the low rate of travel, and a corresponding low rate of compaction per roller. Total weights of these rollers range from 5 to 20 tons with operating speeds of 1-5 mph. A maxi-

mum loose depth of 8 inches is recommended for the heaviest rollers with an average number of passes of 8 per layer. For the smaller rollers, the layer depth should be reduced to 4 inches.

Pneumatic rollers are rubber tired units, either towed or self-propelled. Increased use is being made of this type, particularly for granular or rock materials. The design of pneumatics usually includes independent mounting of one or two wheels on a single, oscillating axle. This permits a tire to penetrate deeper if a soft spot is encountered. The so-called "wobbly-wheel" provides a weaving action to the tire, in addition to the oscillation of the axles. The wobbly wheel is recommended more for routine compaction of embankments, whereas the standard pneumatic is considered a better tool for finishing operations.

A pneumatic roller will have 7 to 13 wheels, with one more wheel in front than in back. In weight, the standard rollers will range from 3 to 12 tons, over a rolling width of 4 to 7 feet. The smallest (7-wheel and 3-ton) units are primarily useful for shoulder compaction. The gross weight has an influence on the depth of compaction. This results because the tire contact area is larger in size as ballast is added to the roller. If too great a load is used, however, the tires will penetrate too deep thus requiring a greater draw-bar pull. The speed ranges up to 18 mph for



Courtesy Seaman-Andwall Corp.

● PNEUMATIC compactors are usually rubber-tired. This one has eight wheels in front and nine at the rear. Weight is adjustable from 7 to 20 tons by ballasting.

Table 1—Characteristics of Standard Rollers

Roller Type	Range of Total Weight (Tons)	Range of Pressure	Recommended lift Height (loose-in.) for 8 passes*		Operating Speed (mph)	Most suitable soil type for use of highway embankment construction
			Heavier Units	Lighter Units		
Three Wheel	5-20	60-500 lbs./in.	6-8	4-6	1-5	Granular, particularly where crushing is desirable
Tandem-Two Axle	3-16	60-500 lbs./in.	6-8	4-6	1-5	"
Tandem-Three Axle	12-20	60-500 lbs./in.	6-8	4-6	1-5	"
Pneumatic	3-12	20- 30 p.s.i.	6-8	4-6	1-15	Sandy, sand-clay, and silts
Super-Compactors	20-50	50- 90 p.s.i.	12-24	12-18	5-10	All types
Sheepsfoot	2-20	100-800 p.s.i.	8-12	6-9	5-10	Clays and silty-clays

*A pass is defined as a single application of a given roller.

the self-propelled units; otherwise, it is limited by the speed of the towing unit. The maximum recommended loose thickness per lift for the heaviest rollers of this type is 7 to 9 inches (loose) and is 4 to 7 inches for the lighter units.

The so-called super-compactors are very heavy pneumatic rollers with fewer wheels. Some models are equipped with oscillating axles while other models are not. The principal difference between super-compactors and standard pneumatic rollers is the number of wheels and the total weight. Weight capacities greater than 15 to 20 tons are normally associated with super-compactors, while the standard heavy rollers of this type range from 25 to 50 tons. Some units have been built, however, that have a capacity of 100 to 200 tons. These latter models had 5 to 6 wheels and were designed primarily for test loading airport runway subgrades and bases.

The Corps of Engineers has been particularly active in the development of heavy-weight rollers. This is due to the need for compacting the large volumes of material for earth dams. Larger teeth on sheepsfoot rollers did not permit a significant increase in layer thickness, besides providing a problem to the drawbar pull required. However, success in achieving adequate densities in lifts up to 24 inches resulted in specifications permitting a 42,000-lb. double-drum sheepsfoot or a 50,000 to 100,000-pound pneumatic roller on cohesive soils, and the pneumatic roller only for granular materials. Furthermore, allowable layer depths for the super-compactors are normally twice that for the sheepsfoot, and two times as many passes are re-

quired for the sheepsfoot as for the 50,000 to 100,000-pound compactors.

Super-compactors of the standard type are available with four wheels in line with an oscillating axle for each two wheels. Rolling widths range from 5 to 9 feet. The tire pressures for super-compactors are 50 to 90 psi as compared to 20 to 30 psi for the smaller pneumatics. There are data that indicate that the super-compactors can obtain effective compaction of 24-inch (loose) lifts. There are little data available as to how much non-uniformity of density (vertically) is developed nor as to the difficulty in mixing water into the lifts that are as great as 18 to 24 inches.

Sheepsfoot rollers normally come in units approximately 5 feet in length, with 3½ to 5-ft. drum diameter. Parallel, independent units of two or three drums are frequently used. For standard rollers, feet are placed in rows of four, and staggered in alternate rows. The shape of the ends of the feet have been made elliptical, round, diamond, and other miscellaneous shapes. The feet are 7 to 10 inches in length,

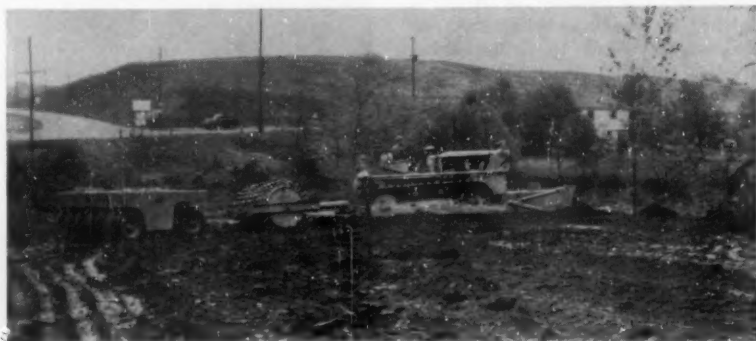
with an end-area of 5 to 10 sq. in. The standard drums (ballasted) are available in sizes which give a complete range of 2 to 20 tons with pressures of 100 to 800 psi. Heavy sheepsfoot rollers with gross weights up to 40 tons have been used.

Loose depths as great as 12 inches can be compacted with the heavier, 9-10-inch length sheepsfoot. Layers of 9 inches are recommended for the lighter, shorter foot-length models. Since the units are towed, the speed is that of the towing unit.

Tampers used for compaction around structures present special problems, primarily those involved with inspection. The height of the lift must be restricted to 4 to 6 inches (loose) with careful attention to complete compaction of a given layer before more material is added. Furthermore, a common failure to incorporate water prevents the development of adequate densities.

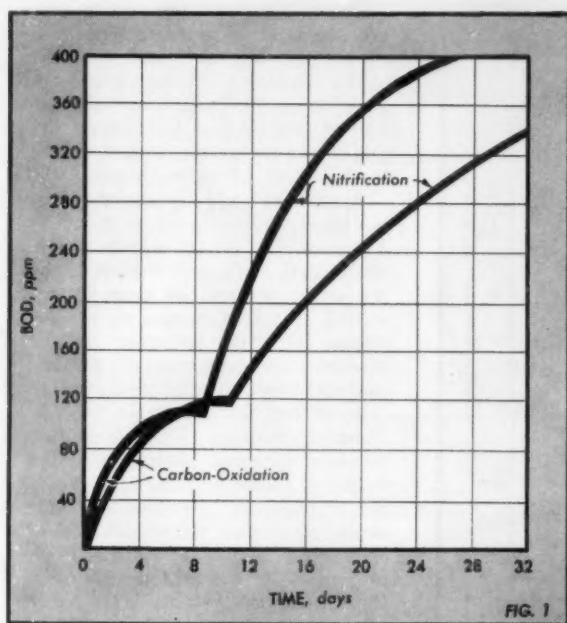
With the constantly changing design and adaptation of rollers, it is necessary to consider the funda-

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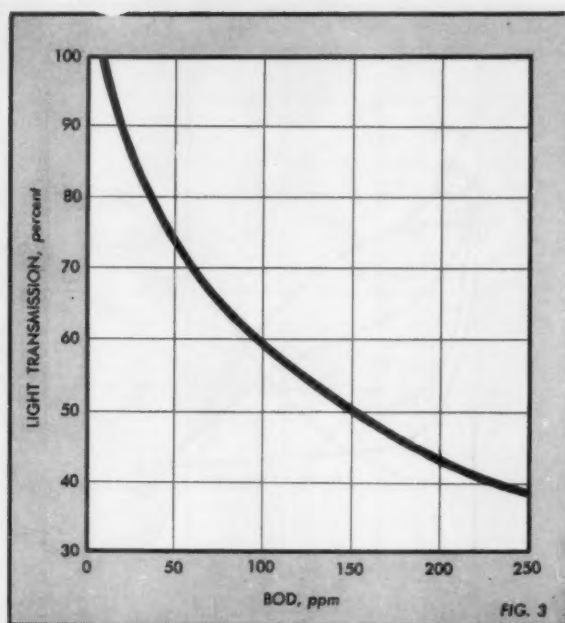


Courtesy Ohio Dep't. of Highways

● PNEUMATIC roller can be used advantageously in tandem with a sheepsfoot as on project on Ohio Route 161. Contractor was V. N. Holderman and Sons, Inc.



● TWO-STAGE character of oxygen demand of sewage, 23°C.



● PILOT PLANT data show BOD-light transmission relation.

STUDIES PROMOTE BETTER UNDERSTANDING of the ACTIVATED SLUDGE PROCESS

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PROGRESSIVE overloading of the existing Ridgewood, N. J., trickling filter plant, which was built in 1924, indicated the need for advance planning, looking toward the enlargement, improvement or replacement of the present facilities. Consequently, the Board of Commissioners retained the services of a consulting engineer to study the problem. At the same time preliminary studies were undertaken at the existing works, for the purpose of collecting information which would be useful in design.

Meanwhile, work at a nearby conventional activated sludge plant, indicated the possibility of using a modification of that process with substantial economy in capital outlay, if a program of research could be carried out at the Ridgewood plant to establish the necessary design criteria.

The Ridgewood Board of Commissioners made available supple-

mental funds for additional laboratory equipment and personnel, instrumentation and pilot plant units. An experimental station was established in 1948 at the Purification Works and a program was developed and undertaken, culminating in the pilot plant studies. This started with a canvass of the literature which yielded much basic information.

The two-stage character of oxidation in sewage through biological forces is illustrated by the BOD curve, Figure 1, adapted from the work of Thomas (1). Preliminary laboratory work at Ridgewood established that in normal domestic sewage, the suspended fraction contains the preponderance of the 5-day BOD, and that a relationship exists between the BOD and the percentage of light transmission permitted in a sewage sample. The percentage light transmission is determined by a photometric test

and is an inverse indication of the strength and character of the sewage.

To obtain more data concerning the physiochemical transformations induced by the biological oxidation mechanism, plain aeration of sewage was studied. Frequent determinations of various significant criteria were made at hourly intervals and the results were plotted graphically on Figure 2. It will be noted that percent values of light transmission are reported; the inverse relationship to BOD may be readily appreciated by referring to the calibration curve, Figure 3. This curve is based on Ridgewood pilot plant data and is similar to the calibration curve developed for the Ridgewood treatment plant and several nearby plants. Use of this eliminated the time-consuming dilution technique for BOD determination and yielded 5-day values in 5 minutes. In setting up the photometer, distilled

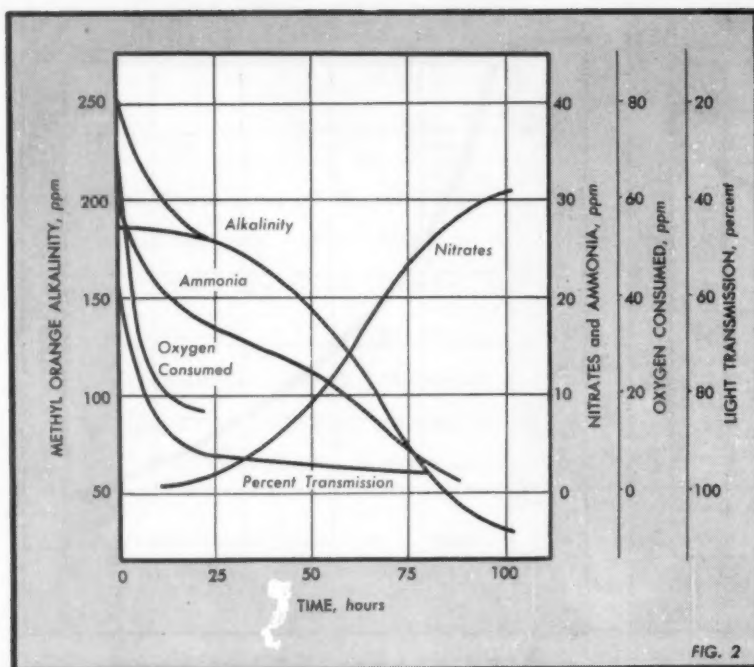


FIG. 2

● VARIATION of several analytical criteria with progressive aeration of sewage.

water is employed as a datum or buffer solution and is assumed to have a value of 100 percent light transmission. A detailed description of the test is available as a public service, from the General Laboratory Supply Co., Paterson, N. J.

Carbonaceous oxidation, involving the reduction of oxygen consumed and BOD values, was of an immediate character, taking precedence

over nitrogenous oxidation. This was confirmed by field work previously conducted on a conventional activated sludge plant, where it was ascertained that adsorption and resulting clarification, yielding high BOD removals, occurred at the inlet end of the aerator; that oxidation of the adsorbed organics followed; and that, subsequent to this carbonaceous oxidation, nitrogenous

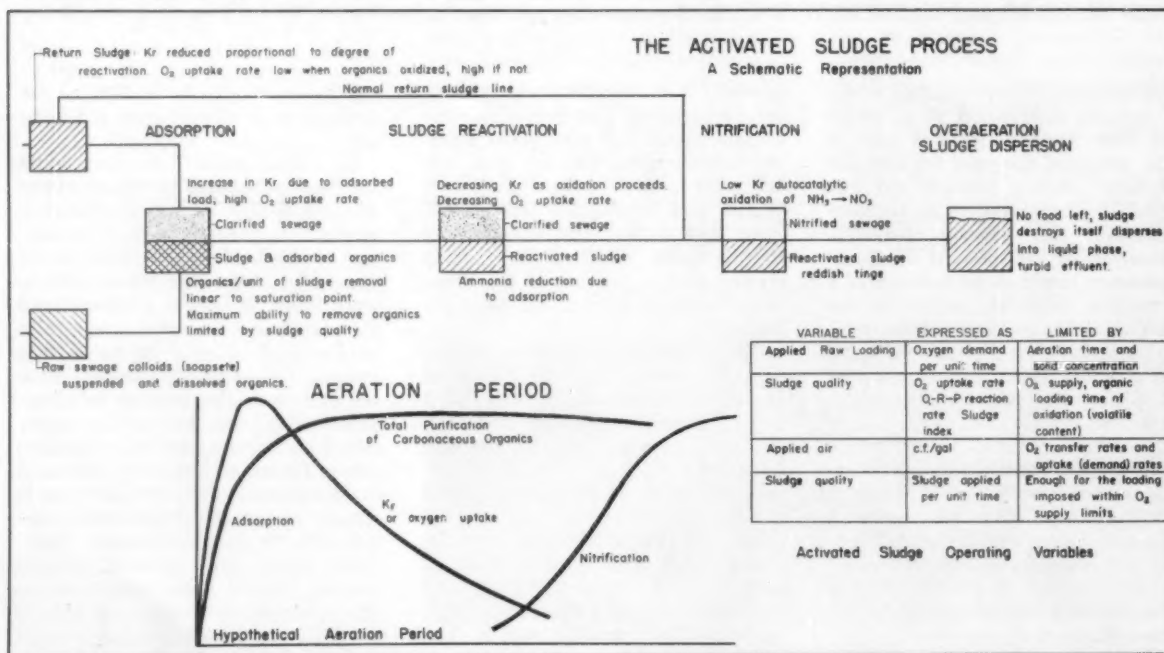
oxidation occurred in varying degree, depending on factors such as air supply, detention, and loading.

The foaming phenomenon did not occur at the commencement of aeration of raw sewage, but toward the end of the carbonaceous and on the threshold of nitrogenous oxidation.

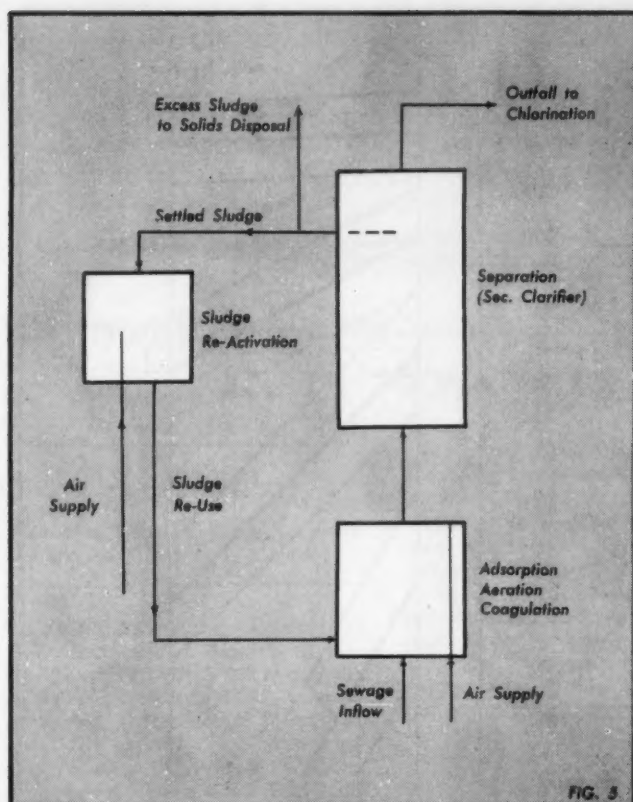
A schematic representation of the activated sludge process is shown in Figure 4. The oxygen uptake value, designated as K_r , and defined as the mg. of O_2 per hr. per gram of dry weight sludge, obtaining at various stages of the activated sludge process were experimentally derived and are shown in relation to stage of process and accompanying physico-chemical changes. The correlation between optimum settling or index value of sludge and the high 5-day BOD removals obtained at this stage, suggested the possibility of separating the reactions by design, in order to attain and maintain these optimum values. The highly adsorptive phase was hence found capable of quickly effecting 90 to 98 percent 5-day BOD removals.

Pilot Plant Studies

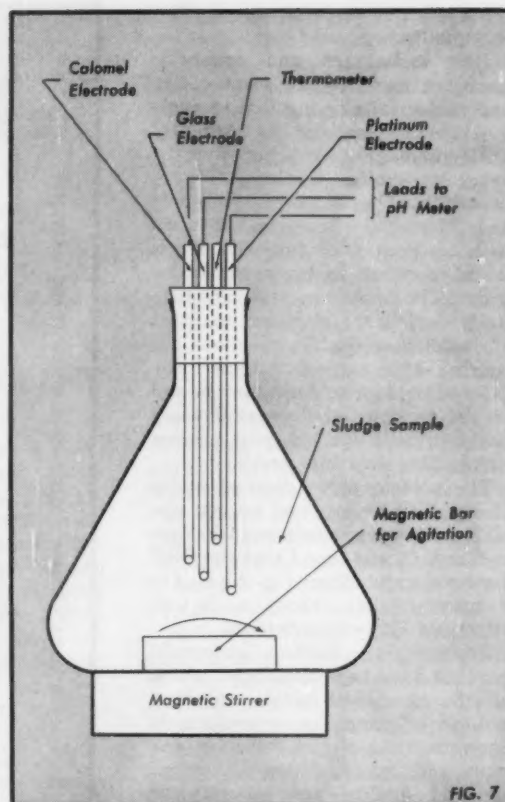
Guided by these considerations, a pilot plant was designed and built. In addition to the conventional primary sedimentation step, it consisted of three simple steps as shown in Fig. 5: (a) adsorption (aeration-coagulation), (b) separation (secondary clarifier), and (c) sludge re-activation. Based upon 1



● FIG. 4. A high degree of adsorption and clarification with resulting low BOD values occurs near the inlet of aerator.



● SCHEMATIC layout of Ridgewood Biological Coagulation Process.



● ASSEMBLY for ORP measurement of sludge activity.

gpm treatment capacity, the detention times were 10-15 mins. for adsorption and 60 mins. each for separation and sludge re-activation.

Commencing February, 1950, this pilot plant was operated for 7 months and yielded a general efficiency above 90 percent 5-day BOD removal. Process operation was as follows: 1. Sewage inflow and re-activated sludge entered the inlet end of the adsorption unit and air was supplied throughout the detention therein. Biological coagulation then occurred, in a manner analogous to chemical coagulation, resulting in a high degree of clarification. 2. The clarified liquor and the biological coagulant with its adsorbed organics were then separated. 3. Precipitated solids were then transferred to the re-activation unit.

A recent application of the process developed by these studies, the Ridgewood Coagulation Process, when applied to a 20-mgd conventionally designed plant, produced some startling results. This plant has 6 aeration tanks of 1 mg capacity each. Sludge index problems, foaming and inadequate 5-day BOD removals had been experienced.

Using only one aeration tank, the plant engineers reported removal of

BOD and suspended solids in the order of 90-95 percent. Improvising with available piping facilities, the inlet end of the tank in service functioned as a sludge re-activation unit and the effluent end as an adsorption unit. Thus, only one-sixth of the original aeration capacity was necessary to afford secondary treatment for the design flow of 20 mgd. and with certain overloads due to storm up to 28 mgd. Inability to transfer the requisite volumes of air required by the enhanced K_r values in the adsorption step, proved a limiting factor and necessitated changes in aeration equipment.

Analytical Procedures and Process Values

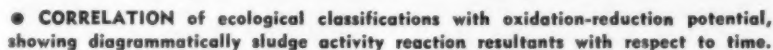
Standard Methods for the Examination of Water, Sewage and Industrial Wastes was largely employed for the evaluation and control of pilot plant operation and performance. To conserve time and effort, calibration curves were developed and employed for the more rapid determination of BOD and suspended solids concentration. Variables encountered in the system such as organic loading, sludge quality and quantity, applied air, time of aeration and oxygen uptake

created manual control problems and dictated further inquiry.

Kolkwitz and Marsson's System of Ecological Classifications (2) provided detailed information concerning the various zones of biological activity. When this system is considered in conjunction with earlier work at Ridgewood, on oxidation-reduction potentials in sewage purification (3), and plotted as shown on Figure 6, it became apparent that uniform effluent quality would result from the establishment and maintenance of an ecological environment conducive to the biological classification responsible for the adsorptive phenomenon.

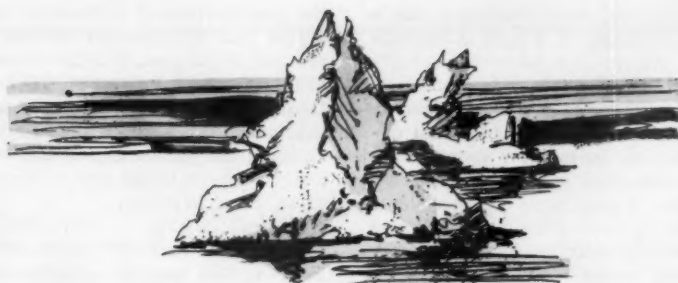
The air supply was varied to maintain constant ORP values in the adsorption unit. Continuous recordings of air demand established a direct relationship between BOD and air delivered to the process. Continuous automatic control of process air requirements was thus accomplished. However, mixed liquor solids concentration and quality continued to be a problem. It was found that controlling the air supply to constant ORP values in the liquid substrate did not necessarily maintain uniform ecology in and on the zoogeal matrix. Variations in sludge quality and activity

Unnecessary construction and operation costs have been incurred by



Built-in flexibility and control enable the operator to maintain optimum process values under a wide range of loading conditions, and at the same time exclude foaming, sludge index, and related problems.

- 1) Thomas, Jr., Harold A., "Analysis of the Biochemical Oxygen Demand Curve," *Sewage Works Journal*, Vol. 12, No. 3, May 1940.
- 2) Whipple, G. C. (as revised by Gordon Maskew Fair and M. S. Whipple), *Microscopy of Drinking Water*, John Wiley & Sons, Inc., New York.
- 3) Hood, John W., "Measurement and Control of Sewage Treatment Process Efficiency by Oxidation-Reduction Potential," *Sewage Works Journal* Vol. 20, No. 4, July 1948.



AN ENGINEERING APPROACH TO WATER TREATMENT

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WHEN AN engineer is first presented with a problem in water treatment, either in a municipality or an industry, he becomes concerned with several factors of classified investigation. He must also consider the related problems of plant operators since they will live with the project after it is completed.

In proceeding with his study of the problem, his first investigations should be regarding the character of the water and the generally indicated treatment. The source of water may be either streams, lakes or reservoirs; or ground water from springs, shallow wells or deep wells. The water may have turbidity or color and be of varied chemical analysis.

Water temperature is a factor that must be considered. The cold waters of Alaska and the Yukon often issue from underneath glaciers, carrying a very finely ground silt which causes a milky turbidity. In these cold waters, frazil ice occurs in needle-like formation and is carried along into headworks of treating plants, often clogging the works.

Seasonal flood stage fluctuations are very important. Even if these adverse factors occur only occasionally during the year, they may upset treatment plant operations for days after they occur. An early warning of such a change in regimen will permit the setting of corrective doses in time to meet the situation of increased turbidity. During rising flood periods, over-treatment is better than under-treatment.

Indicated Treatment—After determining the water quality and its historical record of varying characteristics, the question is what treatment is indicated and required. The indicated treatment is based on use demands which varies with each municipality and industry. With municipalities, water is used not only for domestic purposes and urban industry but also for lawn and park irrigation.

If industry having particular requirements for water quality is a larger user, then treatment should consider the finished water needs of such a major user, if this can be done without raising the total treating cost too high for economic justification.

Methods of Investigation

Conducting the investigations of water supplies and treating facilities requires methods that are accurate, economical in time and adequately comprehensive.

Usually a prolonged sampling and analysis of the water should be made, especially in the case of surface supplies. With large rivers and lake waters there are usually sufficient historical records of quality and quantity to give the engineer information of the conditions most likely to cause seasonal difficulties. This may not be the case with small supplies.

Hypothetical Analyses — Sometimes a raw water analytical record has to be constructed on a river some distance below the confluence of two streams, each stream contributing various salts and impurities with varying flow values. There may be known gaging and quality analyses on both of these streams and also at some point below the required point of diversion for treatment. The analyses below this point may also be influenced by irrigation return water along

both banks of the river. By the laws of proportion and weighted average observations, a hypothetical analysis may be formulated for the point in question. This hypothetical analysis may be checked by making spot sample analyses at data points usually showing marked changes. Should these spot analyses check closely with the hypothetical one, then the entire hydrographic and quality curves may be assumed to be factual.

Run-Off Sampling — With proposed reservoirs, which are fed by small streams, it is desirable to obtain the analyses of such streams, and if possible, to sample the run-off during heavy rains. Turbidity and salts are picked up very quickly from land areas. This is especially true where the rains are seasonal. Changes in water quality are likely to be sudden and fore-knowledge is helpful to cope with required treatment under such conditions.

Return drainage into natural streams from irrigated areas such as rice fields, or from sources of pollution such as oils or phenols, is often troublesome, causing seasonal variation in quality that at times makes satisfactory treatment very expensive.

Analytical Study—Water analyses should be extended to include fluorides and boron. Iron and manganese determination are normal and should be made in the field prior to any possible aeration. Determinations of CO_2 also should be made in the field, or losses in dissolved gases will occur during the time in transit from sampling point to laboratory. These field tests should include alkalinity and pH, since these values are dependent on CO_2 .

In calculating chemical dosages, jar tests for coagulation with various degrees of turbidity and color should always be made. Both iron and aluminum coagulants should be tried at the optimum ranges of pH. Frequently, combination mixtures of alum and iron have been found to be more effective and economical than either coagulant alone. Sodium aluminate in certain cold waters is sometimes economical, and may be used in different combinations with alum. Ferric sulfate in combination with large doses of chlorine has proved effective in removing color which is not amenable to other forms of treatment.

In using jar tests, the turbidity plus color scale units divided by the coagulant, (all in ppm), is called the coagulation ratio. This ratio is a measure of the chemical efficiency

The higher this ratio, the greater is the efficiency.

With low turbidity and color values, a point is reached where a minimum or threshold dose of coagulant will be required. Even if the turbidity and color drop below this point, the same amount of coagulant will be required. This may occur when the annual averages of the turbidity plus 40 percent of the color value, divided by the coagulant used (all in ppm) equals 1.0, although fractional ratios are frequently observed.

It is possible to work out an exponential formula for coagulant requirements for low turbidity and high color values. Such a formula is useful in predicting the annual cost of treatment and in sizing the chemical feed machines.

Since the temperature and seasonal changes in water quality also have a bearing on the amount of coagulant used, any formula may be considered as approximate only. However, estimates may be made within 10 percent accuracy for determining the amount of coagulant required under maximum, minimum and average conditions. Such a degree of accuracy is sufficient when it is considered that the optimum dose is rarely correct to five percent; that most volumetric machines will not feed chemicals more accurately than three percent; and that the volume of water being treated is not gaged more accurately than three percent. Consequently, with variations of plus or minus five percent, the total error may be ten percent.

Water Use Requirements

Irrigation for Lawns and Parks—Since private gardens and public parks often have sensitive plants and grass, the sodium ratio should be below 60 percent. For most sensitive plants, boron should be under 0.5 ppm, with a total solids content under 1,000 ppm; pH should be limited, if possible, between 7.0 to 8.4, although some irrigation waters derived from mining districts have pH as low as 6. Copper (Cu) under 3.0 ppm and chlorides (Cl) under 250 ppm to 300 ppm are desirable. All other elements may be as recommended by the Public Health Service drinking water standards.

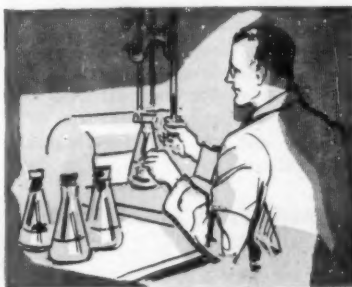
Turbidity must be reduced in drinking water to at least 10 ppm under Public Health Service Standards. However, in all modern water works supplying water for domestic use the aim is to reduce turbidity to less than 0.5 ppm. This limit is also a requirement of bottling works.

For pulp and paper making a maximum turbidity of 5 ppm is permissible. Above this point the quality of the product will be affected.

Color under Public Health Standards is limited to 20 (platinum cobalt scale). In modern water treatment the color is normally reduced to below 5 ppm, with the best plants producing zero color values. Water for photographic purposes, and for bottling works must be color free. For fine paper making, a limit of 5 color scale is the maximum allowable.

Hardness is due to calcium, magnesium and iron salts. This is the major cause of scale in heat exchange equipment. It interferes with wool fabrics and various dyeing processes. It increases the consumption of soap and detergents in laundry use. As a consequence, hardness should be reduced to about 80 ppm. for domestic purposes. Laundries and industry will then be able to treat further this water for their own particular purposes.

Reduction of hardness by the zeolite methods always adds sodium



to the water. If the sodium ratio of this water is over 60 percent after treatment by this method, it will be unsatisfactory for irrigation purposes. In Southern California, the Colorado River water being softened by the zeolite method, is reduced to a lower limit of 120 ppm, since further softening by the zeolite method would increase the sodium ratio above 60 percent. This is a compromise of usual practice of softening to the 80 to 100 ppm limit.

Nitrates over 18 ppm should be reduced to a trace. In young babies, the "blue-baby" syndrome of methemoglobinemia may occur due to ingesting waters having a high nitrate content.

Bottling works and pharmaceutical manufacturing require complete removal of nitrates. With other industries nitrates are of little consequence and need not be removed.

Iron and manganese should be reduced if together they total 0.3 ppm. For photographic solutions and in

the manufacture of carbonated beverages the combination should be reduced to 0.1 ppm. If large amounts of manganese are present, a special treatment is required other than that ordinarily used for iron removal. High manganese can be economically removed by the use of chlorine dioxide and aeration.

Mineral Acidity—Correction of acid water to neutrality is desirable. For irrigation use, the acidity should not be lower than a pH of 6.0.

Requirements for Carbonated Beverages—The requirements for carbonated beverages for soft drinks plants are quite stringent. In addition to being potable, the water must meet the following specifications: Organic matter, turbidity and color, none; taste and odor, none; alkalinity, not more than 85 ppm in terms of calcium carbonate, and usually under 50 ppm; total dissolved solids must be low enough so that the water does not have a saline or brackish taste; there is no limitation on hardness as such; for pH, the water must not contain any free mineral acids, otherwise there is no limitation on pH.

With one variety of root beer, the following are the permissible limits of finished water in ppm: Turbidity: 1; color: 5; taste and odor: none; organic matter: none; algae: none; iron and manganese taken together: 0.1; total dissolved solids 850 ppm; alkalinity: 50 ppm; chlorine: 4-6 ppm, residual chlorine is preferred.

Silica in drinking water has no apparent adverse effects in observed concentrations up to 100 ppm. For individual use such as boiler feed water, the upper limit silica content for pressures of 150 psi. is 40 ppm; for 400 to 600 psi, the maximum is 1 ppm; and in higher pressures it is 0.1 ppm. Sodium silicates have frequently been used as coagulants to assist in the removal of turbidity and iron. Doses of 8 ppm have been used for forming protective coatings on pipes to inhibit corrosion of iron or lead. In high concentrations, a milky turbidity is formed which is not readily removed. Silica removal should be considered in municipal waters that have concentrations over 50 ppm. In secondary use in industry, silica should be removed by special treatment as indicated. Activated magnesia is useful for the partial reduction of silica. Complete removal may be obtained only by ion-exchange methods or by evaporation.

Fluorides—The upper limit for drinking water should be 1 ppm, except in very warm climates where 0.6 ppm is advisable.

Payloader and Backhoe Have Manifold Uses in Public Works

IN A CONTEST sponsored by the Wain-Roy Corporation during the APWA Congress, prizes were offered for listings of the greatest number of useful job applications of the Hough "Payloader"-Wain-Roy Backhoe combination. As announced in the November issue of PUBLIC WORKS, first prize, a \$100 bond, went to Robert C. Garnier of Milwaukee, whose winning list is published below. The second prize was awarded to Willard S. Pratt of Newton, Massachusetts, whose winning paper also is published herewith. It is believed that our readers will find in these lists many new ideas for the use of such modern labor-saving equipment.

78 PAYLOADER and BACKHOE USES

ROBERT C. GARNIER

Assistant City Personnel Director
and Classification Examiner,
Milwaukee, Wisconsin

A. Water Department Activities

1. Digging trenches for laying water mains.
2. Digging trenches for placing new water hydrants and other attached facilities such as gates and gate boxes.
3. Backfilling water main trenches.
4. Lifting water pipes and putting them in place at the construction site.
5. Loading unwanted ground material into trucks for removal from construction site.
6. Leveling ground to grade, particularly around minor construction jobs.
7. At store yard, loading pipe and fittings on trucks to take to the construction site.
8. Loading selected backfill into a truck which takes it to construction site.
9. At the store yard, lifting and placing pipe and fittings in proper place for storage for subsequent efficient use on construction work.
10. For digging trenches or holes on emergency repair jobs, such as broken main or broken fire hydrant.
11. For lifting out of the trench the broken fire hydrant that needs replacing.
12. For setting the new or repaired fire hydrant in place to expedite repair.
13. For trenching, lifting, and backfilling on repairs to gate boxes of various sizes.

14. For lifting and properly placing bags of chemicals at the treatment plant to make such handling easier for the plant laborers.

15. For lifting chlorine cylinders (filled and empty) at the treatment plant, to lessen the strain on plant help, particularly where unusual transfer problems are encountered.

16. In repair work in the treatment plant or pumping station to assist in the loading or unloading of heavy new parts and equipment.

17. In small outside gate houses or other installations that are not equipped with an overhead crane because the initial cost of such equipment could not be justified, the "Payloader" is an emergency work horse able to lift, move, or remove parts and equipment

in the maintenance and repair of such installations.

18. To use as a hoist (with man in bucket) inside plants in the cleaning of high overhead lighting that is otherwise difficult and slow to clean with the use of a ladder.

19. To use as a portable one-man hoist or lift (man in bucket) for close inspection of outside water storage tanks prior to painting and repair work.

20. To use in the painting or repair, as above, of outside water storage tanks that are not too high and where the application (of one man in bucket) could save time and money.

21. To pull shoring loose after in-the-trench work is done so that the greatest amount of shoring will be removed with subsequent savings in material costs, as well as insuring a better all-around job.

B. Sewer Construction, Maintenance and Repair

22. To use as trenching machine in new sewer laying projects, whether storm or sanitary.

23. To place or push backfill material in trench.

24. To move and put in place sections of pipe at the construction site.

25. To load unwanted ground or spoil into trucks for removal from site.

26. For leveling ground to grade at the sewer construction site.

27. For digging trenches and laterals for house drain connections.

28. For driving shoring deeper where other more specialized equipment would not be economical due to infrequent use or need.

29. To remove or pull shoring to save lumber and time. (It is better to cut off sheeting at the level of the top of the pipe to prevent uneven settlement.)

30. At sewer pipe yard, to place, move and lift bulky sewer pipes and fittings.



● EMERGENCY repair jobs are but one of the many uses of the units described in the accompanying article. Time is of the essence on busy streets with heavy traffic.

31. To load sand and gravel on trucks going to sewer construction sites, particularly where operations are not large enough to warrant other loading devices.

32. Where (unlike in 31) regular loading devices (as hoppers) for trucks are justified, the "Payloader" equipment can be used to keep them filled.

33. For digging trenches on emergency repair jobs such as broken sewers or for investigating excessive infiltration or exfiltration problems.

34. For lifting broken pipe from trench and placing new sections.

35. For cleaning out those open-ditch sewers or drains where reach is sufficient.

36. To construct simple low-cost small open ditch drainage channels in outlying areas where no other storm sewers exist.

C. Street Lighting and Electrical Services

37. For efficient digging of trenches for underground conduit for street lighting system.

38. For making excavations for underground transformer stations and manhole facilities.

39. For a (one-man) hoist or lift to replace burned out light bulbs in street lamp standards.

40. Similar to 39 but to facilitate the cleaning of lamps to improve light efficiency.

41. To raise, or assist in raising and placing, lamp posts (reinforced concrete or metal) and other heavy objects where a crane might otherwise be required and to put such standards in place.

42. To load excess ground material into trucks and to keep the general construction site clean without excessive use of hand labor.

43. For digging trenches for conduits needed for the traffic control electrical system.

44. For lifting and raising or lowering transformer units in place where otherwise more specialized but lesser used and more costly equipment (as a crane) would be necessary.

D. Street Construction, Repair and Maintenance

45. At storage yard and asphalt plant, to load trucks with sand, gravel and at times, special asphalt mixes.

46. To keep storage yard area clean and orderly without excessive use of hand labor or specialized single-purpose equipment.

47. At storage yard to keep material hoppers filled where (45) is not practical and in conjunction with that application.

48. At construction site to distribute bituminous mix when, due to necessity, the trucks dump to meet time schedules at mixing plant. This application lessens the need for shovel and wheel-barrow hand labor method of making the distribution.

49. Prior to street construction work to level the site area to grade where more specialized equipment would not



● EXCAVATION of steeply sloping banks offers no problem for a combination unit. Here a bank is being sloped down to provide fill for an area around a pump station.

be economical due to total size of job. Often there is a known minor drainage problem in the street area that can be corrected while avoiding excessive hand labor and subsequent cost.

50. To remove undesirable soil types from street area or street base and place such unwanted soil in trucks.

51. To spread and level gravel or acceptable soil at needed spots in street base area.

52. To mix certain materials on the site in low-cost pavement construction. This would apply in those areas on types of construction where the soil on the site is considered good and an additive is to be made that need not be too thoroughly mixed other than by a few turns.

53. To lift (heavy but small) portable hand-roller onto a truck and to remove it at the next repair site.

54. To use bucket bottom as a tamper or compactor on some repair jobs where specialized equipment is not essential for an acceptable or emergency job.

E. Park and Landscaping Applications

55. To dig trenches for sprinkler systems installed in boulevard and other park areas, including underground gate boxes and related installations.

56. To replace ropes on flag poles by utilizing the principle of the one-man bucket hoist or lift.

57. Digging holes for planting large trees.

58. Loading top soil on trucks for park and garden areas.

59. At nursery, for lifting large trees and placing them in truck.

60. Removing large tree from truck and placing in prepared hole. (57).

61. Accumulating in a pile and lifting excess ground or soil to a truck for removal from the site of a major tree planting operation.

62. For lifting sawed up sections of trees that are cut down into a truck for speedy and safe removal from area.

63. For rooting out unwanted trees and shrubs that would otherwise re-

quire excessive use of hand labor with hand shovels.

64. For saving good top soil at various large public works and other construction sites by pushing it to the side and later loading in trucks for removal to area where needed.

F. Street Sanitation and Snow Removal Applications

65. To load into trucks the scattered piles left by street sweeper units. This can be done on a scheduled basis more efficiently than by using hand labor for loading.

66. To operate at a sanitary landfill or a dump site in necessary leveling and covering operations.

67. To act as a snow plow in pushing snow in smaller areas where regular specialized snow plowing equipment could not be used economically or where such equipment is so short in supply and so much needed elsewhere that valuable time would be lost waiting for it to arrive.

68. To load snow as an end-loader into trucks especially where it would be impossible or difficult to operate a "Snow-Go" type of equipment.

69. To break-up and load onto trucks for removal thick and heavy ice sections that are otherwise difficult to handle.

70. To mix sand and salt in yard storage area for purpose of snow control.

71. To load sand and salt mix or other similar mix in trucks in the early stages of the snow or ice control operation.

72. To load the sand and salt or other similar mix in hoppers for loading into trucks for spreading.

G. Miscellaneous Applications

73. To push, pile, arrange or load properly refuse material at the incinerator plant to avoid excessive use of hand labor.

74. In some weight inspection such as where large scales are being tested for accuracy, the end-loader feature on the "Payloader" would save time

and effort in the handling of the heavy "test weight" units.

75. On a beach area where transferring of material is necessary to improve the "sandy" beach feature, the "Payloader" would be most useful.

76. The trenching bucket feature can also be used to remove unwanted decking from water-front or similar facilities which would otherwise be difficult to remove without excessive time and labor. This applies to small facilities where no major pile problems would be encountered.

77. The equipment could be used as an emergency grave-digging equipment in lieu of specialized equipment where anticipated use is small.

78. The equipment would be useful in Fire Department and Civil Defense applications such as removing debris, loading trucks and making fire breaks of a minor sort.



● SNOW removal in St. Johnsbury, Vermont, where lots of snow is the rule. A Model HH, equipped with a Ram Equipment Sno-Blo, is loading snow into a truck.

More Uses for the Payloader-Backhoe Combination

WILLARD S. PRATT

Director of Public Works,
Newton, Massachusetts

1. Excavating for curbing.
2. Excavating for sewer, water, drain and gas pipe installations.
3. Handling and laying precast curb, water pipe, sewer pipe, drain and gas pipe.
4. Excavating for duct lines for electric, telephone and other types of conduit for control systems.
5. Back filling of trenches.
6. Loading surplus materials.

7. Loading stock materials such as loam, sand, stone and salt.
8. Stripping loam.
9. Loading scarified materials in street construction.
10. Loading snow in snow removal operations.
11. Plowing sidewalks where depth is so great that it has to be raised and piled.
12. Loading sand and gravel from gravel pits.
13. Handling and stockpiling pipe and other heavy articles.
14. Assist in maintenance of equipment where lifting or moving heavy parts are required, such as snow-plows, motors, etc.
15. Towing crippled equipment or starting equipment in winter.

16. Scraping up sand in gutters and loading it when quantity is so great sweepers can't pick it up.

17. Cleaning pools and ponds of silt, where bottom will support equipment.

18. Digging out and removing tree stumps along streets.

19. Cleaning out sump pits not accessible to other types of equipment.

20. Towing pumps, portable compressors and like equipment to and from the job site.

21. Placing cement concrete where transit mix trucks can't be driven directly to the point of placement.

22. Excavation of small ditches or irrigation trenches.

23. Excavation of cellar holes in building construction.

24. Excavation for curtain walls, retaining walls and culvert head walls and wing walls.

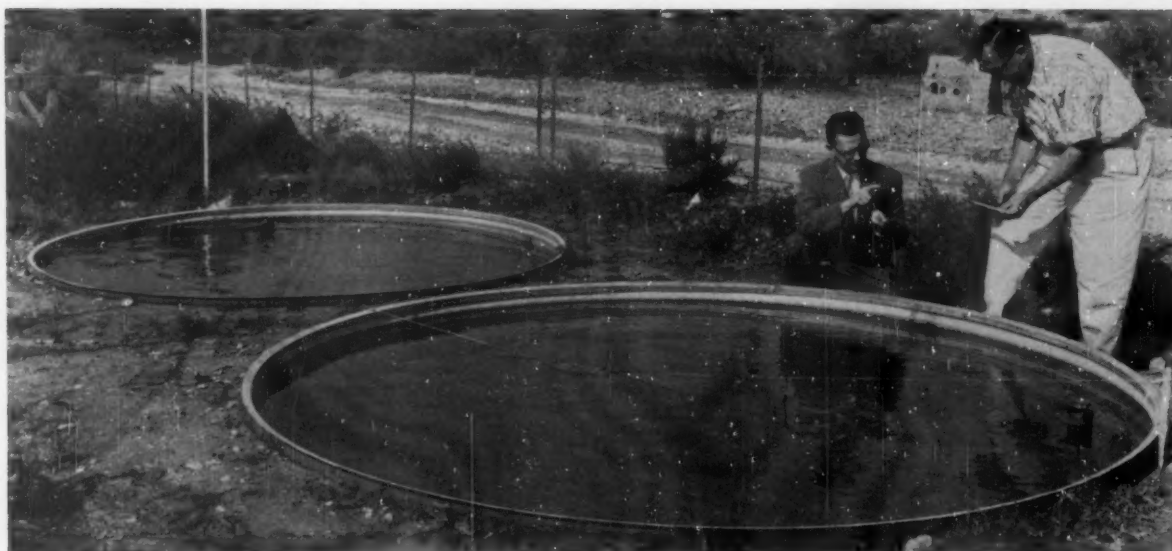
25. Distributing material on grading sites inaccessible to trucks.



● SWEEPER attachment by Ram also permits use of equipment in many phases of street cleaning and debris removal.



● RIGHT-angle digging can be advantageous. Here the digging unit is parallel to the street, out of the way of traffic.



● TEST tank in foreground has been treated with hexadecanol; the other tank is a control. L to R, Dr. Beadle and Mr. Cruse.

EVAPORATION LOSSES and CONTROL

THE FORT WORTH Water Supply comes from the West Fork of the Trinity River, the water being impounded in three reservoirs—Lake Worth, Eagle Mountain Lake and Lake Bridgeport—in that order upstream from the City. Table 1 shows the surface area and the amount of water in storage in these reservoirs on certain dates.

The storage reduction in the three reservoirs during July and August amounted to 33,620 acre-feet, of which 15,800 ac. ft. occurred in July and 17,820 ac. ft. in August. Water used during July amounted to 7,810 ac. ft., and in August, to 7,990 ac. ft. Thus, there was a loss during July (in which there were 21 days over 100°F and 10 days of 90° to 100° temperature) of 10,610 ac. ft. and in August (with 21 plus 100° days) of 7,210 ac. ft. These losses include a very small amount of water used by others, it being estimated that 90 percent of the missing 17,820 ac. ft. could be accounted for by evaporation, transportation, and seepage. Inflow to the reservoirs during these two months was negligible as no rain occurred on the watershed which would produce runoff. The losses from other factors are influenced as follows:

UEL STEPHENS,

Director, Water Department,
Fort Worth, Texas

Seepage: With modern methods such as soil analysis, earth-fill compaction to design densities, core cut-off walls, and sealing over porous areas with impervious blanket materials, seepage losses can be reduced almost to zero.

Transportation: Where water must be transported from the reservoir to its point of use, virtually all loss can be eliminated by constructing pipe lines. In cases where water

must be passed down the river bed, as in the case of water from Lake Bridgeport flowing some 35 miles to Eagle Mountain Lake, the river losses can be materially reduced by straightening the channel, clearing it of undergrowth, and eliminating pools.

At the present time, the Fort Worth Water Department is completing 2500 feet of new river channel. This new construction will eliminate some eight miles of old channel meandering through flat marsh bottom land where the water spreads over the two or three hundred acres of lake bed from which

Table 1—Reservoir Data For July and August, 1956

Reservoir Data	Lake Worth	Eagle Mountain Lake	Lake Bridgeport	Total
Spillway Elevation	594.3	649.1	826.1	
Surface Area—Acres	3800	9000	13,000	25,800
Capacity—Ac. Feet	34,000	191,000	275,000	500,000
Surface Area 7/1/56	2410	5830	2870	11,110
In storage	22,280	95,800	24,200	142,280
Surface Area 8/1/56	2330	5540	2000	9920
In storage	21,460	91,200	11,200	123,860
Surface Area 9/1/56	2290	5160	1750	9200
In storage	19,660	80,000	9000	108,660

the evaporation, transpiration and transportation losses were considerable. The expenditure will amount to about \$7500 which we estimate will be saved annually by reducing water losses.

Transpiration: Some observations have been made on the amount of water used by plants and vegetation. For certain types of water growths such as marsh grass, water hyacinths, willows, etc., the amount of water dissipated into the air is staggering. The only way to prevent these losses is to clear the reservoir of such growths or kill the vegetation by using modern spray compounds which can be applied from the air or by pressure spray machines. Care should be used in selecting the compound to make certain that it will have no toxic effects on livestock, fish life, or people.

Evaporation: For many years study has been given to water losses through evaporation. Water evaporated from reservoir surfaces in the Southwest becomes one of our major considerations in planning a municipal water supply which must depend upon surface storage. I would like to compliment Consulting Engineer Robert L. Lowery for his splendid contribution of factual information on this subject in his paper of May, 1956, "Net Reservoir Evaporation Loss in Texas."

Mr. Lowery's investigations indicate that net evaporation from reservoir surfaces varies from 12 ins. annually in extreme East Texas to 108 ins. in the lower Big Bend area of West Texas. It is interesting to observe that the zones of equal annual evaporation loss lie almost exactly North-South with the 48 in. zone extending south from Lake Dallas by Lake Whitney and on to the Rio Grande near the Cameron-Zapata County line.

The Fort Worth Water Department, in an effort to reduce water lost through evaporation and transpiration is now carrying on a program in Lake Worth which will eliminate some 830 acres of very shallow water surface which is infested with plant growth. Low diversion levees are being constructed; new channels are being excavated; and shoreline changes are being made at an expenditure of about \$10,000.

In December, 1955, a conference, held at the Southwest Research Institute, resulted in a research project to investigate the possibilities of reducing the amount of water lost through evaporation from the surface of reservoirs in the Southwest. A Finance Committee with Colonel E. V. Spence of Big Spring, Chairman, was formed which has to date provided from private subscription \$27,260 to finance the project. Laboratory work was com-

menced in January, 1956, to verify the results of similar experiments being carried on in Australia by Mansfield and in Africa by British scientists.

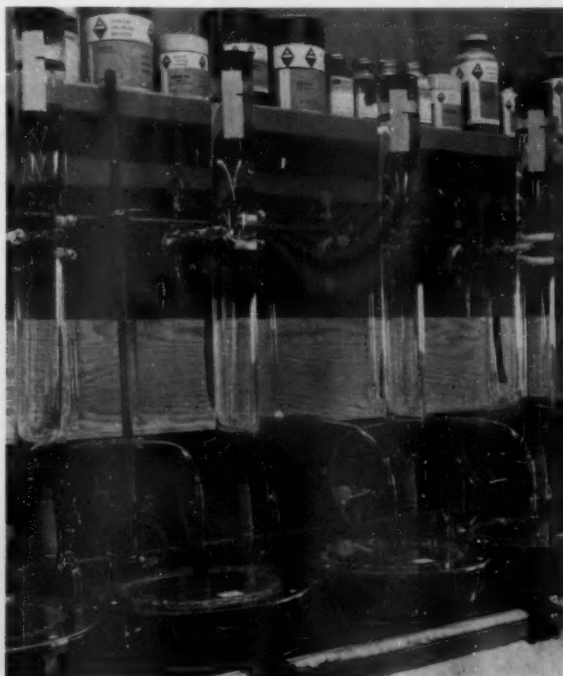
An international conference on the subject of evaporation control was held in San Antonio in April, 1956, which was attended by Dr. Mansfield and other research scientists from several different countries. The exchange of information, review of the literature, and a detailed examination of the work being done at the Institute indicated that it was reasonable to expect that the water lost through evaporation from the surface of a reservoir may be reduced by as much as 40 percent by the application of, and maintaining over the surface, a microscopic film of any one of several of the fatty acids.

Immediately after the laboratory work was well under way at the Institute, the Bureau of Reclamation and the Water Department of Oklahoma City made plans to commence a full-scale experiment on Lake Hefner which is a part of the water supply for Oklahoma City. The research work in Australia is continuing, and so far as we know the work in Africa is also being carried on.

The research program being conducted by the Southwest Research Institute is developing according to the predetermined plan of opera-



● BASIC seepage characteristics of Essar Ranch Lake are being determined by Dick Daum, USGS, as a part of the study.



● EVAPORATION reduction properties of experimental film forming materials are screened by this laboratory apparatus.

tion which was initially conceived to include the following phases: (1) Search of the literature; (2) assembly of samples of chemicals; (3) laboratory experiments; (4) observation of film behavior on 10 ft. open air tanks; (5) observation on small reservoirs of 2 to 4 acres surface area; (6) publication of monthly progress reports and a final report covering the entire program. It was expected that the work would be completed within 18 months, and it now appears that the entire program will be carried out on schedule.

To date the first four phases have been virtually completed, and the observations on a 4-acre pond located on the Essar Ranch southwest of San Antonio are being made. At the same time, laboratory work is underway to test new materials which are being submitted by manufacturers from all over the United States.

Collaborating with the Institute are the Public Health Service, through the Taft Engineering Research Center of Cincinnati, Ohio, which is making tests of the toxic effects of the chemicals; and the U. S. Geological Survey, Denver Office, which is making the field evaporation measurements.

In the laboratory some 135 different chemicals have been tested and screened with the results so far verifying the Australian findings that hexadecanol offers the best possibilities for practical field application and use as a microscopic film forming agent. A preliminary and unofficial report from the Public Health Service laboratories in Cincinnati indicates that it is probably

entirely safe, from a standpoint of toxicity toward plants, animals, or fish.

In placing the hexadecanol film on the 4-acre Essar Ranch pond some difficulties were experienced in maintaining an even distribution over the surface. However, these are mechanical difficulties which further experiments should overcome.

Progress reports from the Institute seem to indicate that based on the laboratory work and the 10-ft. tank experiments (not confirmed to date by the 4-acre Essar Ranch pond experiment) a saving up to 43 percent of the evaporation loss can be accomplished by a properly applied and maintained surface film of hexadecanol. The Institute has made some calculations of the cost of applying the film which indicate that with commercial hexadecanol costing 30 to 40¢ per pound, plus the labor and application cost, with a reduction in evaporative loss of 30 percent, the cost of water saved by the reduction evaporation loss would be about \$1.60 per acre foot or 1 1/2¢ per 1,000 gallons. This is no more than an estimate.

The research program will continue until all of the funds provided have been expended, which will likely be early in 1957. A complete report of the entire program will then be prepared and plans will then be made for continuing the research on a full size lake of not less than 1,000 surface acres; or the research program will be discontinued.

The results accomplished so far by the reservoir evaporation control research work now being carried on

but uncompleted may be summarized as follows:

1. It has been established as a fact that, if properly applied and maintained, a microscopic film of hexadecanol over the surface of water may reduce the evaporation as much as 43 percent.
2. All evidence so far indicates that a film of hexadecanol has no toxic effect on plant, animal, or fish life.
3. Such a film has a property of reforming rapidly if it is broken by wave or other actions.
4. Difficulties have been experienced in applying the chemical and forming and maintaining a suitable film over large surfaces exposed to wind and wave action.
5. Further research and experiments appear to be justified on large size reservoirs, 1000 acres or more in surface area.
6. The cost probably will be well within the value of water saved.
7. Probably the application of a hexadecanol film to small stock ponds can now be justified.

This article was based on a paper presented by Mr. Stephens at the Second Annual Water Conference which was held at Texas A & M College last September. Another article by Mr. Stephens giving details of the shoreline correction work on the Fort Worth reservoirs will appear in an early issue.

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Cost of Refuse Collection and Incineration

In the excellent annual report of the Public Works Department of Newton, Mass., Willard S. Pratt, Director, the cost of incinerating 14,979 tons of rubbish is given as \$3.04 per ton and the average cost of collecting 29,349 tons was \$7.99 per ton, making a total cost of \$9.54 per ton for the complete operation. For garbage, which is collected separately, the total cost of collection and disposal was \$13.98 per ton for a total of 7,377.95 tons.

Light Standards and Trees for Subdivisions

Regulations in North Sacramento, Calif., require subdividers to install electric light standards and street trees approved by the city engineer and the planning commission respectively. The regulations also require fees of \$10 per lot for residential subdivisions and \$50 per acre for commercial or industrial subdivisions to provide suitable area for parks and playgrounds.



● REDUCING evaporation losses by improving shoreline conditions of rivers and reservoirs. The new river channel is shown at right with reclaimed area at left.

Charges

FOR REPAIRING STREET CUTS

THE METHODS of assessing costs against water departments for making and repairing street openings, as well as the amount charged, vary greatly from state to state and even among cities in the same state. The following data are from questionnaires returned to the Editors during the spring and summer of 1956 and answered by engineers and water superintendents.

Alabama—The water department is charged \$10 per cut in Fairhope and the actual cost of street repair in Leeds. In both cases the street department makes the pavement repairs.

Arizona—In Phoenix, the total cost is charged to the water department; in Tucson, the charge is 50 cents per sq. ft.

Arkansas—In De Queen, the plumber making the cut is charged \$15 if the pavement is asphalt and \$50 if it is concrete. The charge in Magnolia is the actual cost; in Marianna there is no charge except for the cost incurred by the water department. El Dorado charges \$7.50 psy.

California—The water department is charged at cost in Alhambra, Arcata, Burbank, Gilroy, La Mesa, Martinez, Pittsburg, Whittier and Yreka; labor and material costs only are made by El Segundo, Grass Valley and Red Bluff. Other charges are: Buena Park, 50 cents per sq. ft.; Huntington Beach, 35 to 75 cents psf; Inglewood, 30 cents to \$2 psf; Ontario, 25 psf; Pomona 35 cents to \$1 psf; Rialto 30 cents; Santa Barbara, 50 to 90 cents; and Santa Monica an \$8 permit and 60 cents psf. Beverly Hills charges 75 cents psf for concrete and 50 cents for asphalt; Fresno \$1.45 psf; Glendale has a cost-plus with a minimum of \$11.00; San Marino is 25 cents to \$1 psf; Pasadena and So. Pasadena charge by area and thickness of pavement. Some phases of these questions were answered by 75 California cities.

Colorado—Denver charges \$3 per lineal foot and Fort Collins \$10 per sq. yd. for concrete and \$3.50 for asphalt. Boulder charges \$3 psy.

Connecticut — New London



● EVERY time a water pipe is laid or a repair made, it is necessary to cut into the street surface. Who repairs and what charge is made is reported by many cities.

charges for actual labor and materials used; Derby charges \$1.35 psf; Hartford \$2 to \$10 psy; and Manchester \$2.25 psy.

District of Columbia—The charges are based on cost and vary with the pavement material.

Florida—Marianna, Miami Springs and Pensacola pay actual cost; in Panama City the charge is \$4.50 psy. In Tampa, the charge averages \$2 psy.

Georgia—With minor exceptions no charges are made against the water department for repair of street openings; except Waycross reports a charge of \$7 psq.

Illinois—Actual costs are charged by Clarendon, Johnston City, Downers Grove, Kankakee and Winnetka; labor and material costs only are made by Chrisman, So. Holland and Riverside. Abingdon charges \$25; Chicago bills at about half cost; Lake Forest at \$9 psy; Lansing charges \$100; Macomb \$16 psy; Maywood \$50 per opening; Rockford \$10 per service cut; and Quincy \$1.50 psy for hard surfaced and 75 cents psf for others.

Indiana—Portland contracts street repair and charges the total cost of the work. Crawfordsville charges

\$8.35 psy for blacktop and \$10 for concrete; Hammond \$1.15 psf; Wabash \$1 psf; and New Albany \$1 permit per job and \$4 to \$5 per hole inspection fee. Other charges are: Shelbyville \$1.50 psf; Terre Haute \$7.50 psy for paved streets and \$5 for sidewalks.

Iowa—Cedar Rapids charges actual cost—time and materials; Creston and Spencer all costs; Jefferson all direct costs; Keokuk the net cost; and Des Moines charges only for asphalt costs and by size of opening.

Kansas—Concordia charges \$1 psf; Emporia charges for labor, material and equipment rental; Fredonia, all costs; Hutchinson \$10; Ottawa, the actual labor and materials; and Topeka, the actual cost. Salina charges 5 cents a cubic ft. for backfill and 75 cents psf for pavement.

Kentucky—Hopkinsville charges \$1.50 psf for concrete, 50 cents psf for others; Carrollton \$1 psf.

Maine—In Belfast, for state highway cuts the charge is \$6 psy; Houlton varies the charge with the type of pavement; tar surface cuts in Livermore Falls are \$3 psy; in Orono, the charge is \$2; in Sanford

the charge is based on cost. Other cities use various methods of charging.

Maryland—In Baltimore, cuts in concrete are \$7.50 psy and in asphalt \$10; in Easton and Hyattsville actual costs are charged.

Massachusetts—Boston, Concord, Seekonk, Warren and Palmer charge actual cost; Middleborough, labor plus material; Sharon all costs; Shirley, about \$15 for "a ditch across the street"; Springfield \$9 to \$25 psy; Swansea and Winchester, actual cost.

Michigan—Escanaba charges 50 cents psf and Jackson \$18 psy. Most other cities charge "actual" or "labor and material" costs; but Albion charges \$25 to \$50 and Battle Creek \$15 to \$25 or \$35, depending on type of pavement. Essexville charges \$4 per ft. and Hillsdale \$10 an opening.

Minnesota—The water department is charged at cost in Ada, Grand Rapids, Jackson, Red Wing, Sauk Centre and Worthington, and cost plus in St. Louis Park. Time and material are charged to the department in Northfield and North St. Paul. Other charges are: Mankato from \$15 to \$40; South St. Paul, 45 cents psy or actual time; Detroit Lakes charges \$25 a hole; Hopkins, \$6 for blacktop, \$10 for concrete and \$4 for gravel. The plumber pays \$5 per hole in Robbinsdale.

Mississippi—The charge varies in Hazlehurst; and in Oxford it is paid from the street maintenance fund. In Grenada, the actual cost is sometimes charged to the water department; in Kosciusko 50 cents psf is collected from the customer; and in Aberdeen the cost is \$1.50 psf.

Missouri—Independence, Trenton and Jackson pay actual cost; in Fredericktown the charge is \$1 psf on concrete and 50 cents on blacktop and in Liberty it is \$1 per cu. ft. on concrete; in No. Kansas City it is according to the size of the hole; in Malden it is a \$7.50 charge for blacktop and \$15 for concrete; in St. Louis it is \$1.50 psf and in Springfield it is approximately \$1 psf.

Nebraska—Labor and material are charged in Hastings and Nebraska City and time and material in Wahoo. Actual costs are charged by Lincoln and Lexington. Tecumseh makes a full charge for breaking and repair and Scottsbluff charges \$6 psy to private parties. In York, the charge is 50 cents to \$1 per ft.

Nevada—Reno has a charge of 45 cents psf.

New Hampshire—Hanover, Manchester, Concord and North Conway

pay actual cost. In Hudson, the charge depends on the size of opening and in Laconia it is usually \$3 to \$4 per cu. yd. Durham makes a charge to the customer.

New Jersey—The water department is charged at cost in Butler, Franklin and Moorestown. Other charges are Highland Park, \$1 per ft; Lambertville, \$7.50 sq. yd; New Brunswick, \$1 psf; South Orange, \$10 psy; Clementon, time and material; in East Paterson the charge is either made to town or to the contractor who desires opening; Flemington, 45 cents psf; Kearney, street openings paid by consumer; Ridgewood, \$5 to \$7 psy; Wayne Twp, bituminous \$6 psy and concrete \$10 psy.

New Mexico—Albuquerque charges \$1.10 psf while in Clovis the charge is 50 cents psf for asphalt and \$1.10 psf for concrete. In Farmington it is \$2 psf and in Roswell \$1.10 psf if it is concrete and 25 cents if it is asphalt.

New York—Actual costs are charged by Binghamton, East Aurora, Highland Falls, Mamaroneck, Pleasantville, Potsdam, Rome, Waverly and Warwick. Other charges are: Garden City, charged against the consumer; Hempstead, street openings made by the plumbers are repaired by contract with a minimum charge or \$20 for light pavement and a minimum charge of \$40 for heavy pavement; Ithaca, 45 cents to \$1.70 psf depending on base; New York City cost varies depending on type of pavement; Peekskill \$3 to \$12 psy; Schenectady \$15 for first yd. and \$10 for all remaining yardage; Boro of Richmond, Staten Island, \$4 to \$7 psy; Utica has a contract rate; Wauertown varies with type of pavement; Watkins Glen charges material and labor; the Amsterdam charge is variable; Glens Falls is \$5 psy; a charge of \$20 is made for permit to cut pavement in Kenmore.

North Carolina—In Chapel Hill, the charge varies; the actual cost is charged in Laurinburg, Elizabeth City and Tarboro. Greenville has a charge of 90 cents psy, Wilmington \$4.50 a yard and Winston-Salem 70 cents psf. In Clinton, the charge depends on the type of pavement; there is a flat charge of \$15 in Statesville. The cost of labor and material is charged in Wilson and \$7.50 per hole in Morehead City. The customer pays the fee according to the pavement in Henderson.

North Dakota—The actual cost is charged in Fargo and Bismarck and the charge varies in Valley City.

Ohio—The water department is

charged at cost in Clyde, Elyria, Lake County, Lima, Celina, Massillon and Lockland. Hamilton has a charge of \$3 psy for surface treated streets and \$4 psy for blacktop; Toledo, \$2 psf; Barberton, \$17.50 psy on paved streets and \$5 psy on unpaved; Painesville 72 cents psf in concrete; in Portsmouth an average of \$1.20 psf is charged; Wellsville, \$3.75 psf; Xenia, \$10 psy; Akron, \$17.50 psy; Salem charges \$12 for average openings; Bexley charges from \$15 to \$25. Cincinnati has a permit fee, plus restoration; and Struthers has a variable cost. Columbus has a cost plus charge; London charges the cost of materials; and Avon Lake has the charge covered in the purchase of the taps.

Oklahoma—Muskogee charges \$10 psy and Oklahoma City has a charge of about \$150 for a pavement cut. In Pryor, the cost is \$10 per cut and Woodward charges the actual cost. Elk City has a charge of \$10 to the property owner.

Oregon—The charge to the water dept in Eugene is \$6 to \$7.50 psy, in Medford the charge is 50 cents psf. Actual cost is charged in Salem and Forest Grove. Other charges are: La Grande, flat charge of \$25; in Cottage Grove, the charge is \$65; the property owner pays in Burns.

Pennsylvania—Emmaus, Johnstown, Grove City, Sharon and Doylestown charge the water department actual cost. Cost varies with the type of pavement in Hazleton, Milton and Wilkes-Barre. Other charges are: Altoona, \$11 psy; Bedford, \$3 psy; Chambersburg, \$4 psy; Gettysburg, \$6 to \$12 a yard; Honesdale \$5 psy; Lebanon, \$8 to \$12 psy; Sayre, \$1.50 psf brick, \$1.25 psf blacktop and \$1.80 psf dirt; Shamokin, \$9 psy non-concrete and \$12 psy concrete; Carlisle, 65 cents psf. Ambridge has a fixed charge of \$1; Kittanning and Frackville \$2, McDonald \$3 and Monessen \$5. Bradford has a cost plus charge, Butler has a charge for a permit and in Corry the state charges a fictitious \$5 for the inspection of the opening. Bangor has a charge for opening and Bradford has a cost plus 20 percent charge. Northumberland has a sq. ft. and sq. yd. cost and Pottsville has a unit cost by area. In Emporium, the charge depends upon conditions and Pittsburgh has no fixed charge.

Rhode Island—The water department is charged the actual cost in Newport; a charge of \$1 a yard is made in Westerly.

South Carolina—The cost is based on the type of pavement in Charles-
(Continued on page 188)



NEWS BULLETINS

AMERICAN PUBLIC WORKS ASSOCIATION, 1313 EAST 60th STREET, CHICAGO 37, ILLINOIS

Bangor Engineer Elected First President of Maine Chapter

Portland, Maine — Forty-four members and guests attended the organizational meeting of the Maine Chapter of the APWA at the Portland City Hall last November 14. The meeting was arranged by State Chairman George J. Maher, Director of Public Works of Lewiston, and was held in conjunction with the 20th Annual Convention of the Maine Municipal Association.

James L. MacLeod, City Engineer of Bangor, was elected President of the newly organized chapter and Roger W. Merrill, Superintendent of Streets of Auburn, was elected Vice-President. The Secretary-Treasurer's post went to F. N. Cunningham, City Engineer of Lewiston. Others elected to serve on the Executive Committee were: Bryan O. Whitney, Commissioner of Public Works, Portland, George J. Maher, Director of Public Works, Lewiston; Leo Morency, Town Manager, Rumford; and Ralph Knowlton, Director of Public Works of Waterville.

The State of Maine was formerly in the jurisdictional area of the New England Chapter. Charles W. Cooke, Director of the Park River Flood Control Commission of Hartford, Connecticut, represented the Association's Board of Directors at the Inaugural Meeting.

The program included tours of two large industrial plants and Portland's public works garage, and a discussion of three interesting topics. The first, titled "Soil-Cement in Maine," was presented by Daniel Webster, District Engineer for the Portland Cement Association. The next paper was titled "Salvaging City Pavements," and was delivered by Charles Parker, Chief Engineer

of the W. H. Hinnman Company. In a paper titled "Ice Control" Donald E. Whitman of the Chemical Corporation told how salt can be used for this purpose; while H. C. Crippens of the Allied Chemical and Dye Corporation explained how calcium chloride is used for ice control purposes.

The next meeting of the new chapter has been scheduled for early April, 1957 in Lewiston.

Weeks Announces Planned Extension of Federal Aid Airport Program

Washington, D.C. — Commerce Secretary Weeks recently announced that plans are being worked out for further "extension" of the Federal Aid Airport Program. The agency plans to develop and announce the fiscal year 1958 program early in the calendar year 1957, or from five to six months in advance of the beginning of fiscal 1958. The early announcement is expected to stimulate planning and speed construction activities.

Congress amended the Federal Aid Airport Act in 1955 to provide a four-year program which would distribute \$251.5 million for Federal aid for airports. It is expected that the allocations for 1956-1957, which have already been made, will see 47 new airports constructed at a cost in Federal funds of \$5.7 million. A total of 502 airports will be improved at an estimated Federal cost of \$85.1 million.

Texas Chapter Holds Tenth Annual Meeting in Lubbock

Lubbock, Texas—N. B. McCullough, Director of Public Works of Lubbock, opened the tenth Annual meeting of the Texas Chapter of the

APWA on Friday, October 26, with an address of welcome. A total of sixty-seven members and guests were in attendance.

Delegates heard three other talks during the morning session. Lynn H. Andrews, Assistant City Manager of San Antonio, discussed traffic control in urban areas; Charles J. Keese, Associate Professor, Civil Engineering, Texas A. & M., sketched trends in sign and signal control; and I. M. Singer, City Attorney of Corpus Christi, discussed various types of legal problems in public works.

In the afternoon J. P. Burden, City Engineer of San Angelo and Vice-President of the Chapter, presided at a session which included a panel discussion of subdivisions and developers' contracts. Panel members were Austin P. Hancock, City Manager of Abilene; R. A. Burleson, Director of Public Works, Grand Prairie; and Jack A. Morton, Assistant City Engineer of Port Arthur. Following the panel session Delbert Ward of the H. B. Zachry Company, San Antonio, discussed street construction; John T. Hickerston, City Engineer of Lubbock, spoke on street maintenance; and an address on streets and utility cuts was made by Robert B. Hayter, City Engineer of Paris.

The delegates enjoyed a breakfast session on Saturday morning which included an invocation by J. R. Hennon, Supt. of Public Works of Port Neches, and an address by Garland Franks, City Manager of Sweetwater. Mr. Franks spoke on personnel problems in Public Works. This was followed by four interesting talks. The first, covering the subject of garbage collection, was presented by Drahm Jones, Director of Public Works of Corpus Christi

OFFICERS: Robert Anderson, Winnetka, Ill., President; Sol Ellenson, Newport News, Virginia, Vice President. **REGIONAL DIRECTORS:** (three year terms) Albert G. Wyler, New Orleans, La.; Wm. D. Hurst, Winnipeg, Manitoba, Canada; Frederick Crane, Buffalo, N. Y.; (two year terms) Jean L. Vincenz, San Diego, Calif.; Leo Flotron, Dayton, Ohio; Roy W. McLeese, Salt Lake City, Utah; (one year terms) K. K. King, Phoenix, Arizona; Charles W. Cooke, Hartford, Conn.; R. V. Moschell, Alcoa, Tennessee. **Immediate Past President,** Edward P. Decher, Newark, N. J. **Donald F. Herrick, Executive Director.**

Georgia Chapter Makes Plans for Spring Meeting



Atlanta, Ga.—Plans for a Spring meeting, to be held in Augusta, were formulated when officials and members of the Georgia Chapter met recently in Atlanta. Pictured from left to right are: (front row) John W. Ball, Jr., Sanitary Engineer, Atlanta, Secretary-Treasurer; L. N. (Red) Hall, Supt. of Sanitation, Albany, President; Grady W. Young, Sanitary Inspector, Atlanta, Vice-President; (back row) M. P. Phillips, Commissioner of Public Works, Augusta; P. H. Chapman, Mayor, Gainesville; D. T. Grider, Supt. of Public Works, Columbus; R. N. Allred, Supt. of Motor Trans., Columbus; B. C. Wallace, Supt. of Sanitation, Marietta; and Riley Milam, City Manager, Gainesville.

and Treasurer of the Chapter. I. E. Nowlin, Assistant Director of Public Works of Fort Worth, discussed refuse disposal. Storm sewers and surface drainage were covered by Gordon Parkhill, Consulting Engineer of Lubbock, and H. H. Stirman, Director of Public Works of Dallas, spoke on alley improvements and weed control.

In the final business session the Chapter passed a resolution of thanks to the Lubbock Public Works

Department for the courtesies it extended to the members during the meeting, and another expressing sorrow at the passing of R. U. Andrews, former Sewer Superintendent for the City of Fort Worth. A new slate of officers was also elected at this meeting, which was held in conjunction with the Annual convention of the Texas League of Municipalities. J. P. Burden, City Engineer, San Angelo, was elected President to succeed H. H. Hester, Supt. of

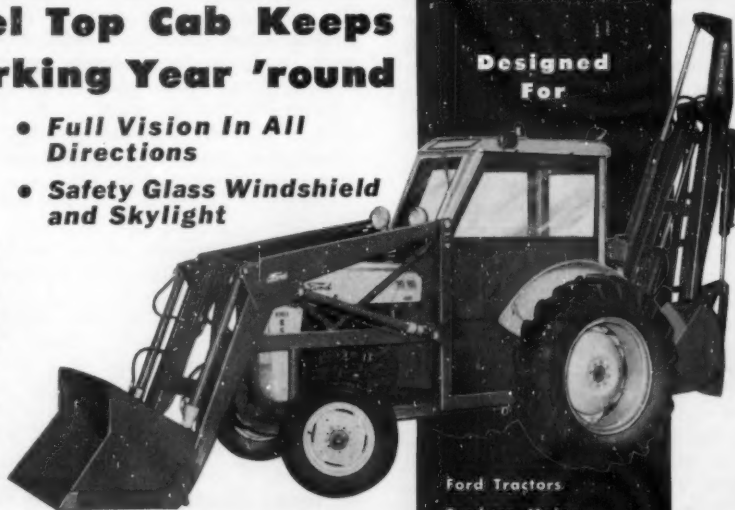
Streets of Fort Worth. Drahn Jones, Director of Public Works of Corpus Christi, was named Vice-President and M. M. Anderson, City Engineer of Abilene was elected Treasurer. Sam Granata, Jr., Director of Public Works of San Antonio, and T. Spencer Love, City Engineer of Southside Place, were elected Trustees. E. E. McAdams, Executive Director of the Texas League of Municipalities continues to serve as Secretary of the Chapter.

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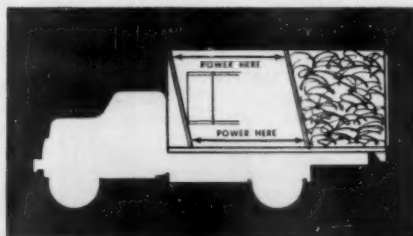
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Recommended Chassis Type — Standard				
14,000 GVW	16,000 GVW	18,000 GVW	22,000 GVW	26,000 GVW (recommend Tandem)
Approx. Cab-to-Axle Dimen.				
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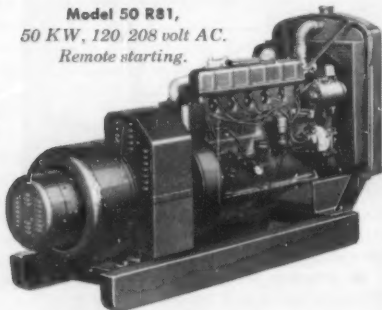
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Survey Shows How Cities Limit Street Use By Building Contractors

Chicago, Ill. — Pedestrians and drivers often fume at the inconvenience of blocked streets and sidewalks where construction is going on. What they probably don't realize is that in most cases there are city rules governing the use of these public areas by building contractors. In many cases the use is limited and a fee charged by the city for the space.

The results of a survey conducted by the City of Wichita, Kansas, when that city was planning to revise its regulations dealing with contractors' use of streets, sidewalks and alleys was recently published in the APWA's monthly News Letter. A questionnaire to cities over 170,000 in population brought replies from 39. It was shown that almost all cities allow some use of these areas for construction materials and machinery.

Baltimore, Md., was the only reporting city that does not allow any such use of a public street. Philadelphia, Penna., prohibits storing building materials on streets in the central business district, but in other sections an area of eight feet from the curb parallel with the construction may be used.

The use of alleys is more varied. Some cities permit occupation of the entire alley, while others base permission upon the minimum space a contractor needs. With respect to sidewalks, 24 responding cities permit use of the entire sidewalk, while others specify the number of feet or state that one-half or one-third may be used.

Twenty-seven of the cities require contractors to pay fees for the use of public passages. About one-fourth reported that they charged a flat fee, either for the number of square feet to be taken up, or for the individual permit. Variations include renewing after 30 or 60 days, or obtaining a special permit for each separate installation.

Seven cities based their fees for use of public space on location, with a higher charge for business districts. Other regulations turned up by the questionnaire include requirement of a deposit in some cities, a surety bond in others.

Sixteen cities reported on traffic aspects of the problem. Of these, ten stated that approval of traffic authorities is required before permits are given to contractors. In six of these cities, traffic officials have the right to deny a permit.



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5144 North Avers St., INdependence 3-0363
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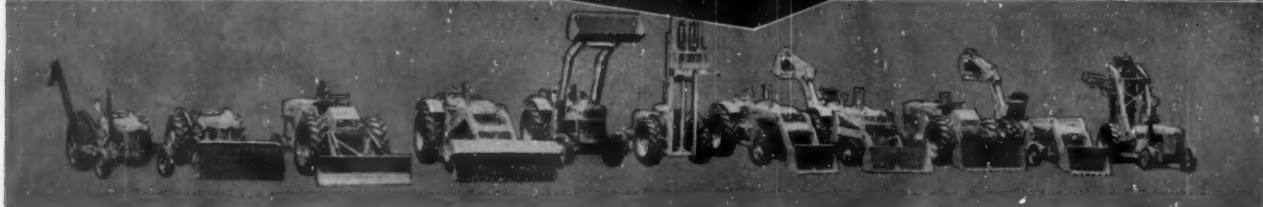
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Here's the first family of machines in this work range built to construction standards with integrated design of both tractors

and attachments. Five tractors (34 to 52 hp) with choice of 20 attachments — loaders, hoes, blades, mowers, trenchers, augers, fork lifts, and others — to handle scores of jobs.



42-HP DAVIS PIT BULL handles either $\frac{3}{4}$ or $\frac{1}{2}$ -yd buckets. Frequently outperforms bigger, more costly shovel-loaders because of overall advanced design, which includes torque converter and "foot-shift" reversing clutches as standard equipment.

WORK BULL MODEL 303 has 42-hp gas or diesel engine. With $\frac{3}{4}$ -yard loader, it pays off on scores of backfilling, loading and stockpiling jobs. Other front-mounted attachments: Angle dozer, fork lift, utility boom, scarifier, sweeper. Powerful hydraulic backhoe.



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BOOKS IN BRIEF

CONTROL OF ALGAE AND AQUATIC PLANTS

A list of references on the control of aquatic plants, including algae, has been prepared by Margaret Greenwald of the Research Division, Chipman Chemical Co., Inc., Bound Brook, N. J. This list, covering 22 pages the size of the one on which this note is printed, is the most complete that we have ever seen. Though not a selected list, emphasis has been placed on recent publications. In most cases, biological and ecological studies have been omitted and emphasis given to identification, evaluation of conditions and plant control. Sent on request to the above address.

WINDSTORM DAMAGE PREVENTION

The National Board of Fire Underwriters has issued a 40-page technical publication, *Windstorm Damage Protection*, which tells how to prevent windstorm damage and help save lives and property. It provides information on tornadoes, hurricanes and other severe storms that in recent years have caused much property damage and the loss of thousands of lives. The booklet is intended for use by architects, engineers and others concerned with building standards. Suggestions are also made for municipal officials to guide their planning for storm emergencies. These include recommendations for pre-disaster planning, for safeguarding water supplies, and for fire prevention and control. Single copies of the booklet may be obtained without charge from the National Board of Fire Underwriters, 85 John Street, New York 38, N. Y.

DURABILITY OF CONCRETE

Bulletin 128 contains two reports concerning durability of concrete. The first paper is "Effect of Entrained Air on Strength and Durability of Concrete with Various Sizes of Aggregates." This is a second report concerning a group of tests designed to provide quantitative information regarding the proper amount of entrained air for adequate frost resistance and the effect of the entrained air on the strength of concretes made with various maximum sizes of aggregate. The second paper is "Resistance of Con-

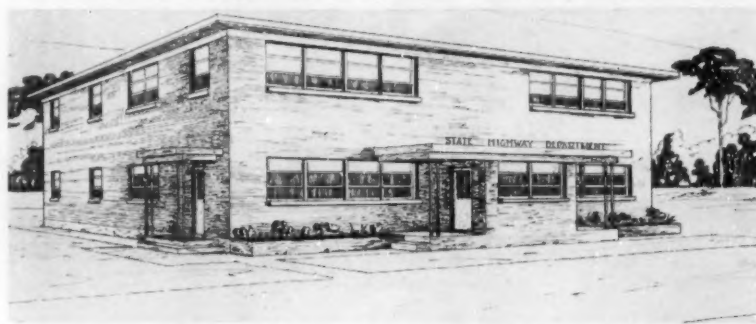
crete Surfaces to Scaling Action of Ice-Removal Agents." This report is a resume of investigations conducted to test materials and procedures for protecting concrete pavements against scaling and disintegration caused by calcium chloride and other thawing agents used for ice removal. Copies from the Highway Research Board, National Research Council, 2101 Constitution, Washington, D.C. Price per copy \$0.90.

DISPOSAL OF SEWAGE AND OTHER WATER-BORNE WASTES

A translation of the latest of 16 editions of Dr. Karl Imhoff's *Taschenbuch der Stadtentwässerung* served as the basis for an easy-reading English work which covers

the subject of sewage in its broadest aspects but devotes most space to treatment and disposal. An unusual feature of the text is the continual comparison of British, German and American practices and the lengthy bibliographies of mixed lingual references. While it is somewhat remindful of two earlier English language modifications of the *Taschenbuch*—*The Arithmetic of Sewage Treatment Works* (1929) and *Sewage Treatment* (1940) both by Imhoff and Fair—it is quite differently organized and has been modernized. Responsibility for this is shared with Dr. Imhoff by a former understudy of his, Dr. W. J. Müller, Perth (Australia) Water, Sewerage and Drainage Dept., and D. B. K. Thistlethwayte, Chief Chemist of the Sydney Water Board. The book is priced at 45 shillings plus postage and may be obtained from Butterworths Scientific Publications, 88 Kingsway, London, W.C.2.

A District Highway Department Office Building



● SOUTH CAROLINA State Highway Department's new district office building.

BIDS HAVE BEEN opened in Columbia, S.C., for construction of a District headquarters highway department office building at North Charleston. The completion of this building will culminate a long-range program to bring the office operations in each district under one roof and to provide each district with adequate office facilities.

The building will have two floors, and will be masonry, structural steel and frame structure. Plans indicate that the new building will be 64 feet, eight inches by 67 feet in size. Outside walls will be of base brick, backed by concrete blocks. A complete air conditioning system was included in the general contract for the new building.

All interior walls will be of painted concrete block masonry. Floors will be concrete covered with


Linotile, and acoustical ceilings will be provided throughout. The building is to be roofed with five-ply coal tar pitch and tarred-felt and will have a gravel finish. Aluminum awning type windows are to be used, and all offices will be equipped with fluorescent lighting.

Space on the first floor will be allotted to the Motor Vehicle Division registration and driver licensing offices, the Highway Patrol and radio facilities. All engineering functions, including offices of the district engineer, maintenance, construction, mechanical and project engineers and draftsmen, will be located on the second floor. Plans storage rooms will also be on the second floor.

This material was abstracted from an article appearing in *Carolina Highways*, Official Publication of the South Carolina State Hwy Dept.

See the **LATEST** in **BIG LOADERS** at the Road Show

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You Can Save Money on SNOW CONTROL

E. C. GLEDHILL

General Manager,
Gledhill Road Machinery Company

THERE ARE very few people who realize what it costs to keep roads and streets open during snow storms and wind storms. The wind has the same effect as the snow in blocking highways by piling up new drifts.

When we have a fairly good snow, the snow crew goes to work and clears the snow off as fast and as cheaply as they can. Next day, we have a wind and the roads become blocked again. The wind blows the snow, making drifts and blocking the roads. It stops traffic. It is a big problem and there is a lot to be learned on how to control snow quickly and cheaply. One very important feature is that the snow plow should have the proper curvature on the moldboard so that it throws and rolls the snow off of the roads. There is a proper curvature to a moldboard that will so roll and throw the snow as to move twice the amount of snow off the highways as a moldboard that is not properly shaped. Poorly designed plows scrape the snow off the roads by sliding the snow along on the moldboard and letting it fall off the rear end. If the moldboard is properly shaped and the proper speed is used, the snow can be thrown and rolled off the road two or three times as well with the same amount of power; and the plow will move it three to four times as far and get it completely out of the way. With the old shaped moldboard, it cost a lot more to clear the road.

We all realize that snow fences will stop the snow and keep it from drifting on the highway. That is a big saving because the snow doesn't get on the highway and doesn't have to be moved.

I am coming to the point that I have learned over a period of years—how another big saving can be accomplished. First, throw the snow with the wind. Make your drift on the lee side of the road in a way that the snow will blow over the highway and drop into the space beyond where you have made your drift. If you make a drift on the wrong side of the road, you are building a snow fence. Wind will carry the snow up to that point, over the top of the drift, and drop it on the highway, and it will have to be removed again. With this practice, millions of dollars can be saved per year in keeping the roads open.

In conclusion, see that the shape of the moldboard is such that it will roll and throw the snow, not scrape it. Don't build a drift which acts like a snow fence and drops the snow into the highway. This is worth knowing and whoever is operating the snow plow should practice this so that when the roads are open, they will stay open, at least until another snow. There are good snow plows and there are poor ones. There are good operators and there are poor operators running the snow plows. There are millions of dollars spent because of the two. If you will study the above and give it some thought, you can keep the roads open for about half the amount of money.

Selecting Compaction Equipment

(Continued from page 128)

mentals of compaction in any effort to comprehend the advantages and disadvantages of a given compactor. The important influences on compaction results are previously listed. It is an understanding of the interrelation between these factors that is necessary in selecting a piece of compaction equipment.

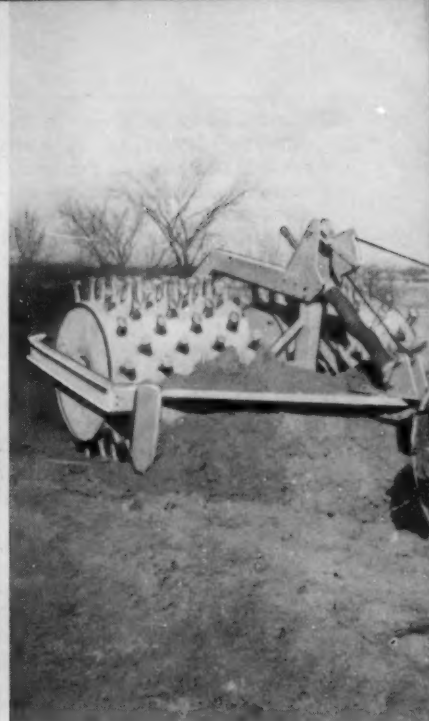
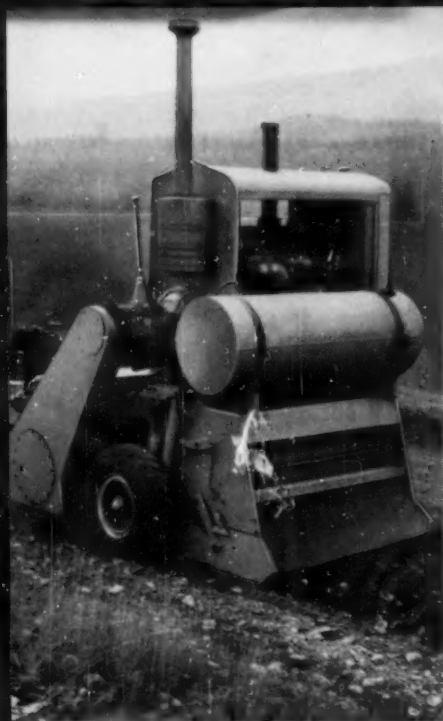
The following discussion approaches the problem of equipment choice from the viewpoint of the construction engineer.

The first consideration for the construction engineer should be the specifications under which the equipment will operate. In some instances, the type of roller, number of passes, moisture content, and layer thickness are dictated and no alternates exist. In other cases, only the maximum layer thickness and moisture are specified and several methods of construction could be followed. Thus, the limits and latitude of the specifications should be fully understood.

Secondly, it is important to realize that more than one type of roller and compaction technique can be successfully used in a given situation. In fact, unless specifically ruled out by the specifications or by job conditions, almost any of the roller-types could be used on any compaction project if other factors are properly evaluated. This is a very important fact, for all too frequently one gets the impression that for a given job, one and only one type of roller is the proper one to use. It is conceivable that one type would be the most efficient, or would produce the best job, but the fact remains, the job of a good construction engineer is to provide the structure called for by the specification and to do so for the least cost. Thus, equipment on hand could prove to be more economical even though less efficient.

Knowing which of his available equipment can be used, and being aware of what types can be purchased and used on the project, the next step is to consider the technical relationships in compaction methods. The following series of questions will be helpful in applying basic principles to the selection:

1. What type of soil is to be compacted, and which roller-type will be best for that soil?
2. Is uniformity of density required or is the "average" density of a soil layer specified? (Turn to page 154)



Bros shows Road Builders 3 ways to reduce roadbed costs in '57

Subbase and subgrade materials from native or over-size rock

Montana photo (left) shows how the Bros PREPARATOR is making substantial savings on subbase costs by reducing native rock at the rate of up to 400 cu. yds. per hr. 22 special alloy steel hammers driven at high speed break rocks along cleavage lines; accepted gradation percentages and clean, sharp angles of friction result in the materials produced. Easily handles up to 24" diameter stuff. It can be towed by any 40 to 50 HP tractor.

This machine is also a real money-maker in pulverizing old blacktop materials for re-use. Reduced to uniform size, materials are easily blended with new asphalts.

Base and surface course materials mixed faster and to greater depths

Minnesota photo (center) shows the Bros ROTO-MIXER using every bit of its "beef" in mixing old road materials full of big rock, slab-like asphalts and cobblestones; heavy-duty design brought it through without damage. The machine features a 6" solid steel rotor shaft; simplified split-sleeve tool plates, load absorbing tool sockets, variable speed transmission and independent hydraulic control of the hood and the rotor.

These features add up to correct control of mixes, minimum of repair and breakdowns and deeper and faster mixes.

Earthfill materials bladed and compacted in one operation

Minnesota photo (right) shows Bros LEVEL BLADE ATTACHMENT combining grading and rolling into one operation on a regrading project. This dual effort eliminated a patrol grader from the embankment job. Consolidation allowed scrapers to run in high gear; two to three extra hauls per hour were reported. Equal or greater densities than giant tampers achieved on this project also resulted from this combination blade-roller work.

Consolidating old roadbed materials in a horizontal stockpile with the blade-roller permits scrapers to spread on top without bogging down. Spring-loaded blade has 7½" vertical adjustment for cross-overs and grading in gumbo.

• • •

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3. What leeway is given in the depth of layers to be compacted, and what is the maximum depth that can be efficiently compacted by the roller (s) under consideration?
4. Will water have to be added to the soil before compaction?
5. How many passes will be required of the roller(s) for the layer depth, and the soil density desired?
6. What range of production rate is possible by varying the layer depth and the soil moisture and the number of passes?
7. What is the estimated cost of compaction per cubic yard under the variable conditions of roller, layer depth, number of passes and moisture incorporation?

General answers to these questions are included in part in Table I. As to soil type and equipment, granular materials are best compacted by a vibratory action, and clay-type soils by compression. Equipment that will come closest to providing these types of actions are to be preferred when the given soil types are encountered. Furthermore, tamping rollers are not effective with granular materials. Smooth wheel rollers are more suitable for granular materials, particularly if some crushing action is desired. The depth of the layer is not unduly influenced by the soil type, except where large rock (2 to 3 feet in diameter) is involved. Obviously, such materials require dynamic rather than tamping action.

Questions 2 to 6, inclusive, deal with the interrelationships between layer depth, moisture content, number of passes, pressure and type of equipment which are not constant. It is not practical analytically to determine values nor to devise a formula which can be easily solved. The best approach is to study each variable in light of a particular piece of equipment. This is possible through a study of the literature, through information from the equipment producers, and by careful observations and cost accounting techniques.

One method for evaluating the relative influence of the several variables is through test fills. More and more frequently on very large earth moving projects test fill installations are required or encouraged. In such cases, a section which is not to be included in the final project is constructed using alternate methods for compaction. This is a particularly valuable procedure

because many variables can be tested which otherwise could not be evaluated. A critical factor is always the incorporation of water. If the loose embankment material has adequate moisture, greater layer depths may be possible. Frequently this factor can best be determined by field trials. The rapidity with which the soil will dry, and the influences of compacting on the dry and on the wet side of optimum can be determined. Furthermore, if the hauling equipment is similar to that to be used on full-scale production, its beneficial effects will be included.

On many projects, test fills may be considered as impractical. In such instances, variations in layer thickness, number of passes, type of equipment, and soil moisture can be incorporated into some of the first fills to be compacted. While this might require some re-compaction, the value derived may be sufficient to more than offset the double cost for a few layers.

These test fills are of most value if super-compactors are feasible, because none of the other equipment can compact more than a 12-inch lift. In fact, unless a very heavy sheepfoot with 8-10-inch (length) feet is available, a maximum lift of 9 inches is recommended. However, variations in soil moisture, effect of construction equipment, and number of passes are factors of economic importance that can be evaluated.

Surface roller efficiency depends upon total weight, size of the area over which the load is applied, and the pressure. As might be expected, with a greater total weight, a thicker layer can be effectively compacted. There is a limiting pressure for a given soil, above which shear failures or plastic flow rather than compaction will develop. In other words, the soil is "shoved" to one side rather than compacted. By increasing the loaded area, the total weight can be increased without unduly affecting the pressure applied. Therefore, as a general rule, the greater the weight the greater the depth that can be compacted in a single lift, subject to shear problems which develop if the pressures are too great.

It is a well understood fact that a loose soil will have a lower bearing capacity than the same soil in a denser state. As used here, bearing capacity is assumed to be equal to the pressure applied to produce a certain penetration of the soil. Thus, when a roller is first placed on the loose material, very little

support is offered until considerable penetration or deflection of the soil occurs. For the second and subsequent passes, the bearing capacity is considerably higher (penetration is less) if densification is occurring.

A new technique for compacting cohesive soils known as "stage compaction," employs to advantage the increase in bearing capacity per pass. For the first two or three coverages of the roller, maximum efficiency (and speed) can be achieved by a relatively small roller since it will not penetrate or "sink in" quite as far. Subsequently, as the soil becomes denser a heavier roller is employed. As many as three stages can be utilized to advantage under proper conditions. The heavier the load for equal tire pressures, the more contact area and the more difficult (and slower) is the compaction. For sheepfoot rollers stage compaction is not too effective unless the roller sinks to the point where contact is made between the drum and the soil. The lighter rollers may be incapable of producing adequate densities for the lift thickness involved. However, with the density that is achieved, the increase in bearing capacity will permit additional compactive loads rather than introducing shear failures such as develop when heavier rollers are used on the loose soil.

The question as to the proper unit pressure for sheepfoot rollers is difficult to answer. One method that has been suggested employs laboratory CBR methods. If the test is conducted at or near the optimum moisture content, the ultimate bearing capacity of the soil may be estimated for the area of the sheepfoot. The CBR value is converted to pounds per square inch for the penetration desired, and this value is treated as a maximum pressure for the sheepfoot.

The costs of highway embankment compaction will range between 10 and 25 cents per cubic yard. The higher value is well above efficient operations under most conditions. On Corps of Engineers work, savings of 2 to 5 cents per cubic yard have been accomplished by proper considerations of roller type, layer thickness, moisture content and soil type. On very large projects, this represents a substantial savings, as well as a significant percentage of the cost of the compaction item.

In conclusion, the selection of compaction equipment is an economic decision that can best be made by a consideration of funda-

mental compaction principles. No standard operating procedure should be anticipated, although the size of the jobs, the personnel available, and limited equipment may indicate that one type of procedure is the most economical for a given construction firm. If the specifications permit wide latitude in the construction procedures, then each project should be examined for the interrelationship between type of equipment, layer depth, number of passes, and soil moisture requirements. Test fills represent an excellent technique for determining these interrelations. Where test fills are not feasible, carefully observed sections at the beginning of the project may be helpful. Experience gained through accurate observations and adequate cost accounting methods will continue to be the major source of information for most construction engineers.

The writer wishes to express his appreciation to the Ohio Department of Highways and also to Charles H. Shepard of that organization for the photographs contained herein.

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Water and Sewage Chemistry and Chemicals

Completely revised, expanded and brought up to date by Kenneth W. Cosens, this reprint is of special interest to everyone engaged in water and sewage works. Full color illustrations are used to show the exact nature of colorimetric reaction in some specific laboratory tests—something that is possible only with this type of color work.

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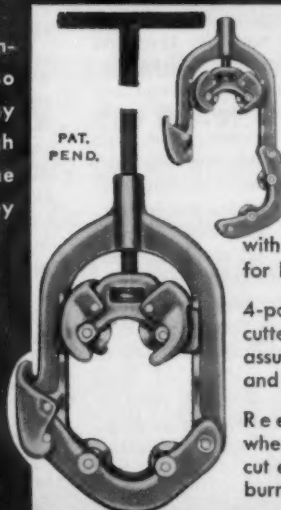
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PUBLIC WORKS DIGESTS

THE SEWERAGE AND REFUSE DIGEST

Membrane Filtering Of Activated Sludge

For measuring the aeration solids in activated sludge mixed liquors, the present practice of using either the aluminum dish or Gooch crucible method has definite limitations and does not quantitatively determine all the organisms present because many of the non-flocculent organisms pass through the filter medium. Filter membranes as fabricated today have a calculated pore size of 0.4 to 0.45 micron, thus retaining all particles, including bacteria, larger than 0.5 micron. This paper describes a procedure and precision associated with the membrane filter method of determining suspended solids in such liquor. The authors state that, in addition to the technical ease and rapidity offered by this method, the precision in the determination of activated sludge mixed liquor suspended solids was greater than that reported for the methods given in the 10th edition of "Standard Methods." The standard deviations with activated sludge suspended solids, ranging from 276 to 4,746 mg per liter, were for the most part less than 1.6%. Data were also given to show that this method can be adapted to the suspended solids analysis of raw sewage. The high cost of the filter membrane was considered to be the only detrimental factor associated with its use in routine analyses. But for research studies it is superior to all other methods and worth the additional expense.

"Membrane Filter Method Applied to Activated Sludge Suspended Solids Determinations". By Richard S. Engelbrecht, Ass't. Prof. of San. Eng., Univ. of Illinois; and Ross E. McKinney, Ass't. Prof. of San. Eng., M. I. T. *Sewage and Industrial Wastes*, November.

Lagooning Raw Sewage

The city of Kearney, Nebraska, learning that primary treatment only of its sewage would suffice for discharging it into the Platte river,

investigated the lagoon method of treatment. The North Dakota health authorities had recommended providing one acre of lagoon for each 100 people, which would mean that Kearney would have to provide at least 100 acres. Considering the extreme porosity of the sandy soil in the Platte valley, it seemed possible that a smaller area would suffice; and a 10-acre raw sewage lagoon was constructed to receive, on an experimental basis, the municipal wastes from Kearney, which discharges about 1,637 lb. of BOD per day. The lagoon was constructed in a seemingly unfavorable type of soil, and its size was considered inadequate to handle the total waste load. A co-operative investigation involving the city of Kearney, the Nebraska State Department of Health, and the Water Supply and Water Pollution Control Program of the U. S. Public Health Service was initiated to evaluate performance of a lagoon in sandy soil, adaptability of lagoon treatment to the geographical location, possible effects upon ground water, and the capacity required for adequate waste treatment.

Proposed operation of the lagoon was modified by high initial losses to seepage, and the study was discontinued at an earlier-than-anticipated date due to the presence of detergents in ground water. Consistent operation was obtained largely during the months when the lagoon received the total volume of sewage.

During seasons favorable to algal growth and when receiving the total load of sewage, the lagoon afforded BOD and coliform reductions comparable to those provided by conventional secondary treatment. Decreased loading did not result in any substantial increase in percentage of waste removal. Treatment declined to the primary range during colder weather when algae were sparse or lacking. Settleable solids were lacking in the lagoon effluent, but lagoon turbidity, chiefly influenced by non-settling plankters, frequently greatly exceeded that of

raw sewage. Floating solids occurred to a limited extent during early phases of operation. Locally unpleasant odors developed during extended anaerobic periods. Organic bottom deposits were absent except in one small shallow area. Oxygen content varied with density and relative activity of plankton algae, diurnally and annually; BOD reduction was most marked during seasons of algal growth. Maximum removal of BOD was 173 lb. per acre per day. Average removal was about 128 lb. per acre per day. Loading ranged from 38 to 217 lb. of BOD per acre per day.

Lagoon seepage followed an unexpected course away from the adjacent stream and produced detergents in nearby wells. The detergent was carried about three-fourths of a mile in ground water in 14 months. Coliform-type bacteria were markedly reduced during seasons of prolific algal growth. Anaerobic conditions permitted greater survival. Algal growth varied on a seasonal basis, its density apparently being controlled by available solar energy. Maximum development was associated with solar radiation levels of at least 600 langleyes. Zooplankton was densest during periods of greatest algal growth. Lagoon capacity was adequate for all sewage from the city during favorable weather conditions. Increased size would be necessary during colder seasons.

"Experimental Lagooning of Raw Sewage". By Joe K. Neel and Glen J. Hopkins, of U.S. Public Health Service. *Sewage and Industrial Wastes*, November.

Scum Control In an Open Digester

Of the two digesters at the University of Florida sewage treatment plant, each 30 ft. in diameter and 20 ft. effective depth, one was built without a cover, to permit a study of the feasibility of operating an open unheated digester in Florida. This digester is loaded with sludge pumped directly from primary clarifiers designed for a 2.0-hr. detention

The CLEVELAND 80W



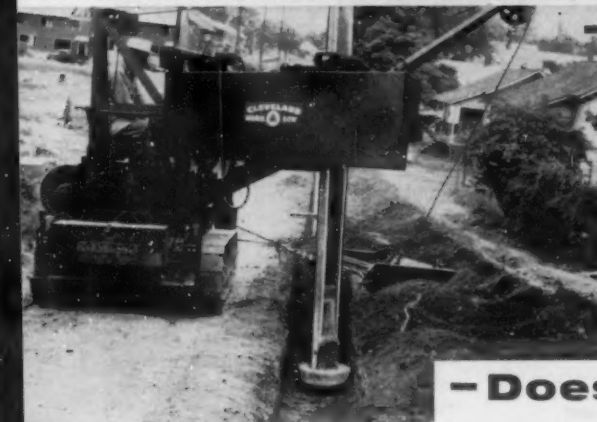
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period. The chief difficulty in operating was a heavy scum blanket which formed to a depth of 6 to 7 ft, rendering ineffective 30% of the tank capacity. Pockets of raw solids formed in the scum blanket directly over the raw sludge pipe inlet. To remedy this, recirculation was tried but proved ineffective. Rodding was fairly effective but time-consuming and dangerous to the operator. Circulating weekly by use of a portable pump was fairly effective but time-consuming. A method of recirculating suggested by E. A. Cox, consulting engineer, has proved to be the best solution.

This consists of drawing sludge from the 6-ft. level by two bladeless impeller centrifugal pumps, each rated at 75 gpm, and discharging it above the scum blanket adjacent to the digester wall at an angle to the liquid level. A scum blanket more than 6 ft. thick was completely dispersed and the digester contents thoroughly mixed; complete control was obtained by operating the pumps 6 hr. on two consecutive days each week. The best action did not necessarily result from a high velocity discharge. There are now no flies or odors around the digester. Recirculation was practiced only

during hours of direct sunlight, which not only prevented loss of the heat inherent in the raw sludge, but distributed through the tank the heat contributed to the surface by the sun.

"Open-Digester Scum Control". By George J. Lohmeyer, Supt. Sewage and Industrial Wastes, November.

Suppressing Lagoon Odor

Last summer the heating system for the digester at Regina, Saskatchewan, broke down, and undigested sludge was deposited in lagoons. This emitted hydrogen sulfide gas which was carried to a nearby residential area. As a temporary and expensive palliative, after ineffective use of sodium nitrate and pump-spraying the lagoon, a crop-dusting firm was employed to spread Sanfax 37-D by spraying from a height of 3 ft. The entire site was covered in three or four minutes, using 55 gal. of chemical and an equal amount of water. Two or three dustings a week at \$175 per application gave complete odor control until the heating equipment had been reconditioned.

"Keeping Down Odor". *Engineering News-Record*, Nov. 1.

Refuse Sanitation In Ohio

In 1950 the Ohio Dept. of Health made a state-wide survey of the garbage and refuse disposal methods employed by the municipalities and other political subdivisions of the state. Of the 121 cities, 33% had complete municipal collection, 5% contracted for it, and 33% relied on private haulers. Better storage conditions and collection services were found where there was municipal collection. Open dumps or hog feeding farms were used by 65% of the cities; 25% used incinerators, and 10% had sanitary landfills. Since then, 29 cities have replaced privately operated collection services with complete municipal service; and 49 more have adopted sanitary landfill. Some problems are difficult to solve, including disposal of non-combustible refuse in large cities; high cost for small municipalities surrounded by built-up areas; and economic problems. Counties have been slow to act, although the state legislature has made it possible for the commissioners of a county to set up refuse collection and disposal districts. In 1955 the Ohio Dept. of Health decided to sponsor sev-

(Please turn to page 162)



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engineers

Long term performance under all conditions is gained by your client. The permanence and root resistance of JC-60 protect the entire investment of a sewer system for years to come.

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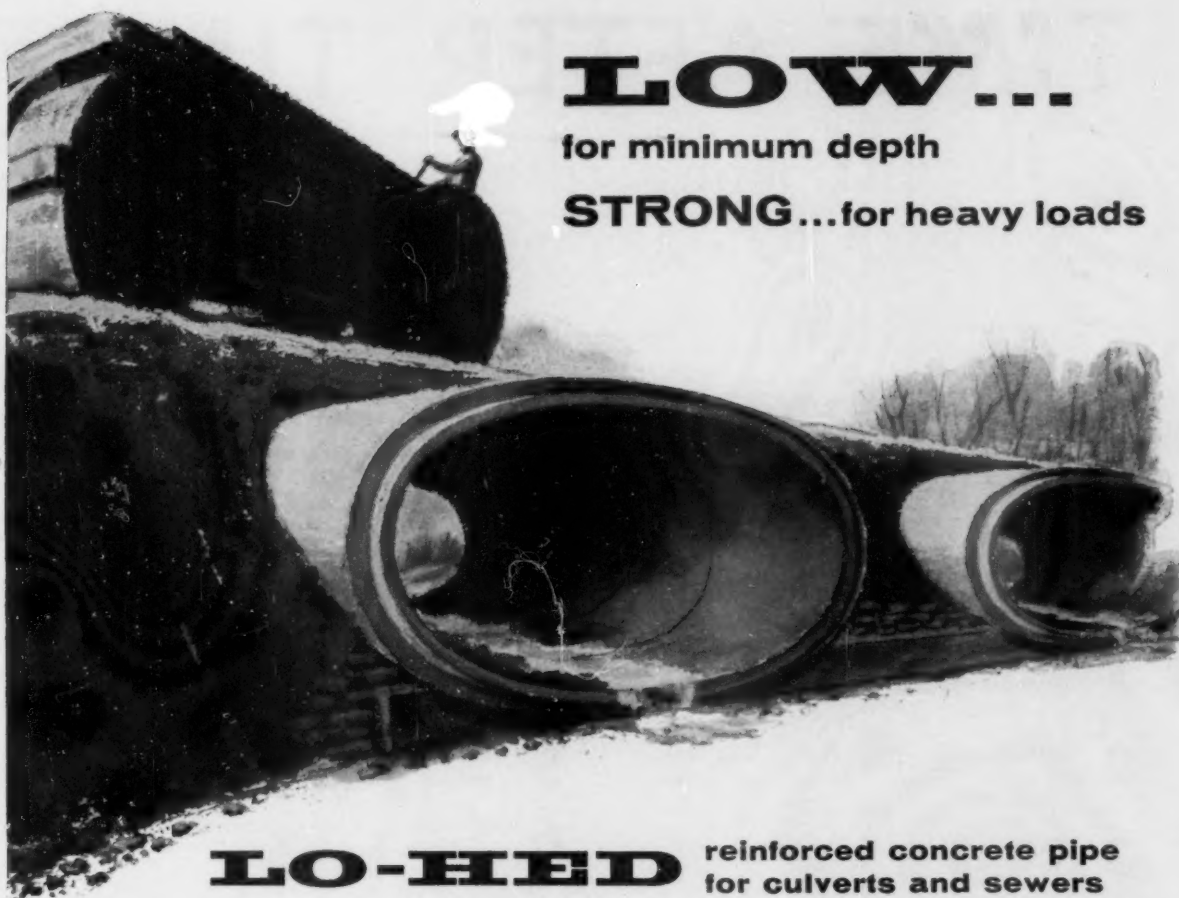
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for culverts and sewers

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Trickling Filters with T. F. F. I. SPECIFICATION VITRIFIED CLAY UNDERDRAIN BLOCKS for Sewage Treatment Plants

because

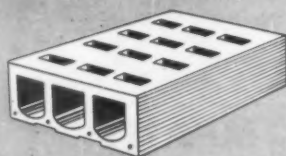
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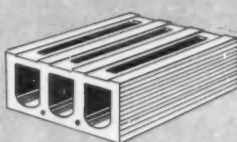
Recommended Underdrain Specifications

Standard Specifications for Vitrified Clay Filter Blocks for Trickling Filters are given in full on pages 37 and 38 of the 1954 revised edition of the **HANDBOOK OF TRICKLING FILTER DESIGN**. These specifications cover types of blocks, compressive strength, absorption, shape, permissible variations, apertures, shell and web thickness, drainage channels, workmanship, markings, testing — everything that an engineer needs to write specifications for trickling filter blocks. Secure your copy from any TFFI member listed below.

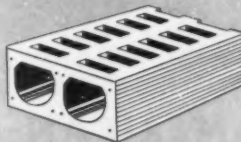
TRICKLING FILTER



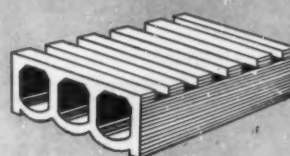
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W. S. Dickey Clay Mfg. Co.
902 Walnut St.
Kansas City 6, Mo.



POMONA
Pomona Terra-Cotta Co.
Pomona, N. Car.



ARMCRE
Ayer-McCurel Clay Co., Inc.
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TRANSLOT
Texas Vitrified Pipe Co.
Mineral Wells, Texas.

ENGINEERS SPECIFY



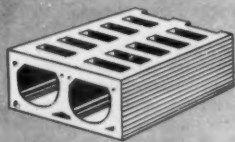
Trickling filters in Sewage Treatment Plant, Alexandria, Virginia

Designed by Greeley & Hansen, Consulting Engineers,
Chicago 4, Illinois

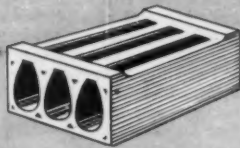
Construction by James McHugh Construction Co.,
Chicago 37, Illinois

Equipment: Pumps: Worthington, Yeomans, and Marlow; Rotary Distributors, Walker Process Equipment Inc.; Gas control and heat exchanger, Pacific Flush Tank Co.; Sludge Gas Engines, Climax Engine & Pump Mfg. Co.; Chlorinators, Wallace & Tiernan and Fischer & Porter, Digester Equipment, Dorr-Oliver Inc.

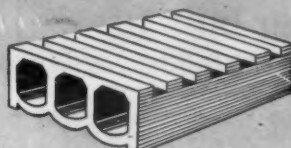
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Symbol of
good treatment

eral refuse clinics over the state for public officials and other interested parties to discuss refuse problems, with the Ohio Municipal League and the Ohio Association of Public Health Sanitarians as co-sponsors. Eight clinics have been held to date, each attended by approximately 100 public officials. The authors cite, as examples of the progress being made, what has been done by a number of cities and villages and two counties.

"Good Refuse Sanitation Is Not Impossible". By G. H. Eagle and S. M. Overman, of Ohio Dept. of Health. *Public Works*, December.

Treatment of Domestic and Industrial Sewage

Charlotte, N. C., in 1956 completed a plant for treating an average of 10 mgd, with a peak of 20 mgd, of mixed domestic and industrial sewage. After primary clarification, the sewage is passed through three roughing trickling filters 4 ft. 2 in. deep, the primary purpose of which is to absorb the shock loads created by industrial waste. Then recirculated effluent is added at rates of 10 mgd for minimum flow (2.4 mgd) to 5 mgd for maximum flow of 20 mgd. The remaining effluent is aerated at

a design rate of 1 cu. ft. of air per gallon of sewage, and passed through secondary clarifiers. Sludge digestion uses the Laboon sludge concentration process. The effluent from the plant averages 6 ppm of BOD and of suspended solids, the plant efficiencies ranging from 96% to 98%.

"Charlotte's Newest Sewage Treatment Plant". By George S. Rawlins and Thomas H. Tassos, Engineers. *Water & Sewage Works*, November.

Photographing The Inside of a Sewer


At Fresno, Calif. last summer the condition of 625 ft. of a 54-inch sewer was ascertained by photographing it without the inconvenience, danger or expense of sending a man through it. A waterproof camera mounted on spraddled wheels, was pulled through the sewer, taking pairs of stereoscopic pictures every 2½ ft., each picture showing conditions 30 to 40 ft. ahead. The camera, on its "straddlebug" was lowered down a manhole, and its front end fastened to a cable attached to a winch at another manhole 1300 ft. away, which pulled the camera through the sewer. The

camera was operated electrically through a trailing cable. This device is operated by Laval Underground Surveys for inspecting sewer and water lines 6 in. to 6 ft. in diameter. In the Fresno survey, 250 pairs of stereoscopic pictures were taken at a total cost of \$250.

"Underground Surveys of Water and Sewage Installations". *Public Works*, December.

Composting Organic Wastes

The author presents his conclusions from observations of an experimental pilot plant constructed in 1953 by the Michigan State University Civil Engineering Dept. The digester was a modified Earp-Thomas type, with a capacity of 5 tons per day. (It was suggested that what is called a "digester" should really be called a humidifier). Garbage from the city of East Lansing was composted in the unit over a 2-year period. Breakdowns were numerous and mechanical difficulties made operation difficult. There were some odor nuisances and a well composted material was not always produced. In spite of this, it is thought that composting will be more and more widely used for



CHAMP
of heavy duty diesels

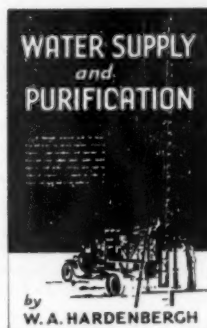
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AN authoritative yet simple treatment of the subject by one of the nation's foremost authorities, whose editorial and field work have brought him in close contact with the problems that trouble the average engineer. Design examples of all kinds are worked out in detail to illustrate practical, up-to-date methods. Among the major changes introduced in this latest edition are the following: the chapters on ground water, on filtration, and on laying pipe and maintaining lines have been almost completely rewritten; the chapters on pipe conduits and on disinfection have been revised to bring the material in them up to date and a new chapter has been added on fluoridation.

Order your copy today

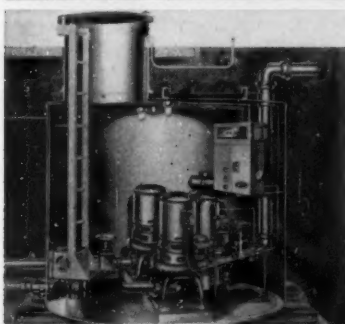
Smith & Loveless

BUILDS FIVE (5) SEWAGE LIFT STATIONS FOR INDIANOLA, MISSISSIPPI



When bids were received for a sewer system at Indianola, Mississippi the cost of five (5) concrete lift stations exceeded the available funds.

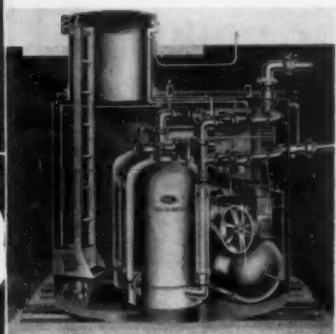
To reduce the cost of these stations the consulting engineers, Ewin Engineering Corporation of Mobile, Alabama, prepared new plans and specifications for factory-built lift stations as manufactured by Smith & Loveless, Inc.



ALL **S&L** PRODUCTS
ARE
PERMANENTLY PROTECTED
WITH
"VERSAPOX"

The Indianola lift stations recently installed are of both pump and ejector types as follows:

ONE — 8' diameter duplex pump station with 600 G.P.M. pumps.



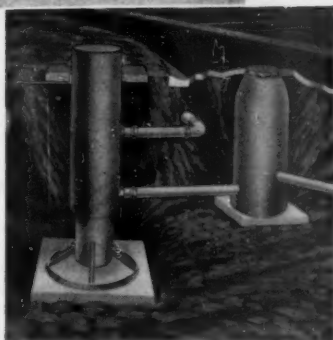
TWO — 8' diameter "Way-O-Matic" duplex pneumatic ejector stations with 100 G.P.M. ejectors.

ONE — 9'-6" diameter "Way-O-Matic" duplex pneumatic ejector station with 200 G.P.M. ejectors.

For job recommendations, complete specifications and drawings—all part of the latest edition of the 100 page Smith & Loveless lift station Data Manual



WRITE
DEPARTMENT 40



ONE — 4' diameter "Mon-O-Ject" single pneumatic ejector station with 40 G.P.M. ejector and stand-by motor, compressor and controls.

Hundreds of cities are reducing costs with Smith & Loveless "proven quality" lift stations.



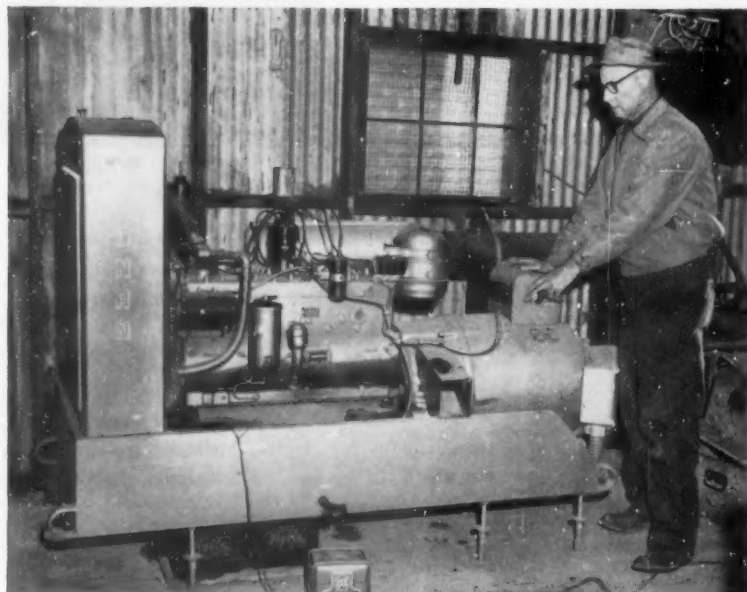
Smith & Loveless, Inc.
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KANSAS CITY, MISSOURI

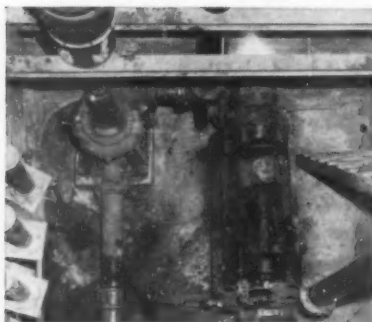
PLANT: MERRIAM, KANSAS

REPRESENTATIVES IN PRINCIPAL CITIES

How the city of Gridley (Calif.) GIVES SEWAGE A LIFT



...with **ONAN** EMERGENCY ELECTRIC POWER



These two electrically-driven pumps lift sewage 25 feet to the out-fall line. During a power outage, electricity from the Onan Standby Plant keeps them pumping.

500 TO 75,000 WATTS

Air-cooled, gasoline-powered:
500 to 10,000 watts.
Water-cooled, gasoline-powered:
10,000 to 75,000 watts.
Air-cooled, Diesel-powered:
3,000 and 5,000 watts.

At one point in the Gridley sewage system, sewage has to be pumped up 25 feet to the out-fall line. Two electrically-driven centrifugal pumps do the job. But any interruption of utility power to these pumps would cause sewage to back up and could put the system out of operation.

To make sure this doesn't happen, Gridley has installed an Onan 35,000-watt gasoline-engine-driven electric plant in the lift station. When utility power is interrupted, the Onan plant takes over, keeps the pumps going.

Gridley has another 35KW Onan unit mounted on a heavy-duty trailer which can be quickly towed to any spot needing power. A big fire recently blacked-out a big part of Gridley and for 3 hours the Onan Electric Plant kept that part of town supplied with light and power.

Built in many models and sizes, Onan Electric Plants serve as emergency units for fire and police departments, civil defense, and other municipal services. Lightweight Onan portable plants are used by fire, street, and park departments for electricity where utility power is not available.

Write for folder and specifications

D. W. ONAN  **& SONS INC.**
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treating solid organic wastes. Because of the absence of adequate machinery and equipment and the almost complete absence of technical know-how by sanitary engineers, it cannot be anticipated that composting can be begun at once on a widespread commercial basis. But there is sufficient information available to lead to the design of proper equipment and methods in the not-too-distant future.

In addition to operating this plant (which is described in the article), excess garbage was composted by the windrow method for a few weeks. This garbage was ground and piled in windrows about 6 ft. wide and 3 ft. high, and mixed with a soil shredder, and a reasonably satisfactory product was produced in seven to twelve days. Objectionable odors caused the discontinuance of this experiment.

"Recent Developments in the Composting of Organic Wastes", By Robert F. McCauley, Assoc. Prof. of Civil & San. Eng. *Water & Sewage Works*, November.

Other Articles

"Corrugated Metal Sewers Go In Along the Raritan," 60-in. to 84-in., bituminous lined. *Engineering News-Record*, Nov. 15.

"Effect of Various Organic Substances on Oxygen Absorption Efficiency." By W. Wesley Eckenfelder, Asst. Prof. of C. E., Manhattan College, and students Lawrence W. Raymond and Donald T. Lauria. *Sewage and Industrial Wastes*, November.

"Rational Design of Large Interconnected Storm Sewers," including allowance for surcharging, compared with standard methods of design. By Robert J. Fletcher. *Public Works*, December.

"Parr Sewage Works (of St. Helens) Will Reduce Pollution of One of the Foulest Rivers in U. K." Activated sludge treatment of sewage from 135,580 people. *Municipal Engineering (England)*, Oct. 26.

"Underwater Core Drill Opens Nozzles of Sewage Disposal Grit" at the bottom of New York Bay. By William L. Acker, Pres., Acker Drill Co. *Public Works*, December.

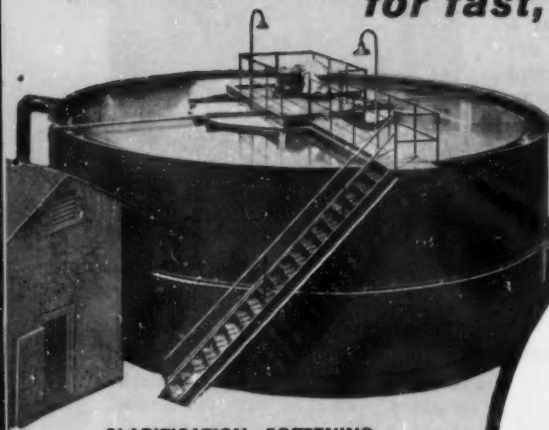
Bibliography on Fluoridation

A comprehensive and valuable bibliography on fluoridation has been prepared by the Municipal Reference Library, 1006 City-County Building, Detroit 26, Mich. This is mimeographed, 8 pages in length. A limited number of copies are available on request to Lawrence Wember, Chief, Municipal Reference Library at the above address.

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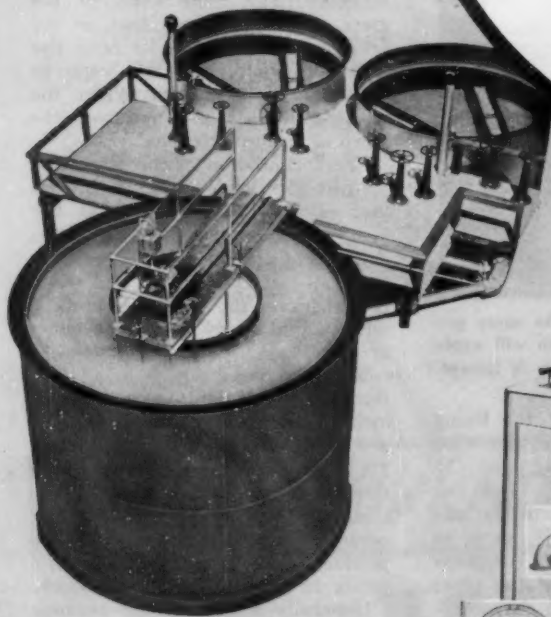
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The **ACCELAPAK**® treating plant is a complete water clarification or softening plant in a single installation. It includes an "ACCELATOR" treating plant, a slurry feeder, a **NEUSOL**® feeder, a Rate of Flow Controller, and a Gravity or Pressure Filter. A **HYDRODARCO** PURIFIER for removal of excess chlorine is optional equipment.

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If you want greater volume, in less space, at less cost, it will pay you to investigate **INFILCO**. The largest and most experienced organization in the field is at your service. Write today for bulletins and complete information.

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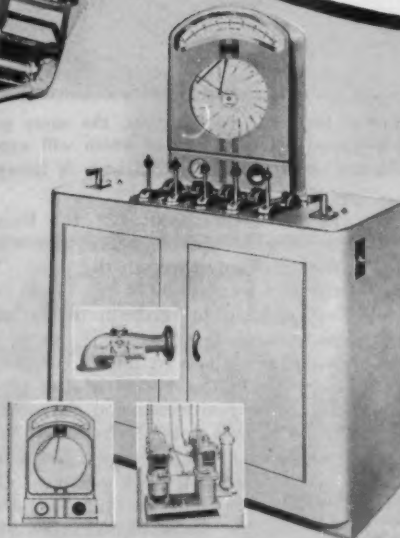
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5637-PW



FILTER CONTROLLERS AND GAUGES

The **C.-A.-P. SYSTEM**® instruments afford pneumatic control for the operation of water treatment plants. They provide sensitive flow control as well as accurate measurement of loss of head and rates of flow, contributing substantially to maximum efficiency in plant operation.

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DRY FEEDERS

The **E FEEDER** is the only feeder with a linear setting for adjusting the rate of feed throughout the capacity range of the feeder. It is an extrusion type feeder which operates by imparting simultaneously both a rocking and reciprocal motion to the feed pan. Type E feeders are furnished for either constant rate or automatic proportional feeding.

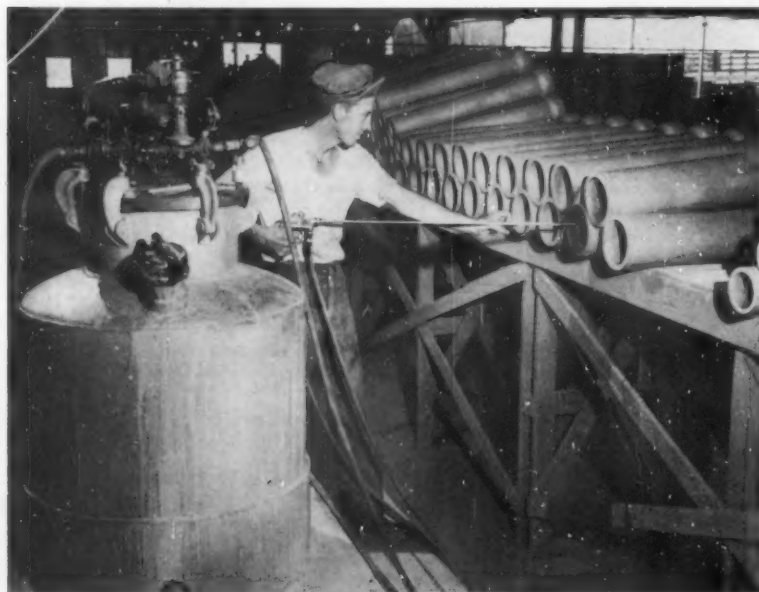
Request Bulletin 215-CC

SEWER PIPE IS GLASS LINED

SEWER PIPE, with a ceramic glaze rather than the conventional salt glaze, is being used increasingly by municipalities in Texas and other areas of the Southwest. Originated by the Texas Vitri-fied Pipe Company of Mineral Wells, the new ceramic glazed pipe is being produced at the rate of some two million feet per year. Dallas has already laid well over a half million feet of the new pipe, and several other municipalities have

Ceramic Service Staff of Metal & Thermit Corporation. Ultrox, a zirconium opacifier, is an important batch ingredient to obtain uniformity of color, glaze durability and proper fit of glaze to the clay body.

The ceramic glazing process imparts a number of desirable properties which may be summarized as follows: (1) The interior surface or lining is of impervious, chemically resistant glass whose properties can be accurately controlled and uni-



● **SPRAYING** the glaze on the interior of the pipe. At this time, the spray gun is operated manually, but automatic equipment will be installed which will apply glaze material to the interior of the "green" pipe as soon as the body is formed.

installed quantities approaching that footage.

"We have been using ceramic glazed pipe from Texas-Vit Company since they began to furnish it in this area," says Henry J. Graeser, Superintendent, Dallas City Water Works and also of the Dallas Sewerage System. "We normally use clay pipe selectively in the areas supplied by wells, which have a high sulphate content and also in industrial areas where acid wastes might be expected."

The ceramic glaze is mixed according to a formula developed by ceramic engineers of Texas Vitri-fied in cooperation with the

formly reproduced; (2) the lining is very smooth and provides easy flow of fluids through the pipe; (3) thermal expansion of the glaze can be adjusted to conform to the expansion of the pipe body, so as to leave the glaze in slight compression inside the barrel of the pipe; (4) controlled expansion characteristics avoid unequal stresses in the cross section of the pipe when subjected to temperature changes; (5) the glaze is fused at high temperature to the body of the pipe and becomes an integral part of the pipe.

The clay pipe body is produced on forming equipment in a conven-



● **STANDARD** pipe-laying techniques are used in sewer line construction.

tional manner and dried in the usual way. After drying, the interior surface is sprayed with the ceramic glaze which is forced through the spray gun by pressure from the storage tank. The first layer is sprayed as the gun is projected through the length of the pipe on the first pass. A second layer is sprayed on the return stroke.

The pipe is then set on tunnel kiln cars and fired according to schedule. The composition of the glaze mixture assures that as the firing process reaches its peak the clay body and the glaze begin to mature simultaneously. When the body and glaze are matured, the ware is uniformly cooled.

The formulation of the glaze also assures the same cooling rate as that of the body, as well as the same relative expansion. As a result, the glaze actually becomes an integral part of the pipe and when cooled leaves the inside of the pipe with a uniformly smooth coating of glass.

The glass-lined pipe is being produced in both four-inch and six-inch diameters. Standard lengths are 4 ft. for the four-inch and 3½ ft. for the six-inch. Present production is confined to the conventional bell and spigot style, but the ceramic glazed pipe will soon be produced with mechanical Plastisol joints in both 4-inch and 6-inch.

Generally speaking, the ceramic glazing will always be somewhat more expensive to apply than the salt glaze, but the process produces pipe with superior properties and a glaze that can be accurately controlled. Installation of automatic handling and spraying equipment will ultimately reduce the cost of the glass-lined variety.

Combined MILITARY-CIVIC CENTER Adds Permanent Health Insurance

During World War II, the Air Force built a flight base near the quiet little Georgia town of Warner Robins. Almost overnight, it became a bustling city . . . and it has continued to expand ever since. By 1950, its population had reached nearly 8,000. Today, it is estimated at 17,000, and Warner Robins is also the civic center for another 16,000 living on the adjacent military reservation. The city has settled down to steady, long-term growth.

Warner Robins is providing "health insurance" for its future with *permanent* Vitrified Clay Pipe. More than 96,000 additional feet of Clay Pipe in diameters up to 30 inches was recently installed, together with a treatment plant that can be expanded to serve a community of 30,000. Warner Robins, following the lead of many growing cities, is set for the future—with the *only* sewer pipe that *never wears out*.

Mayor: W. T. Giles.

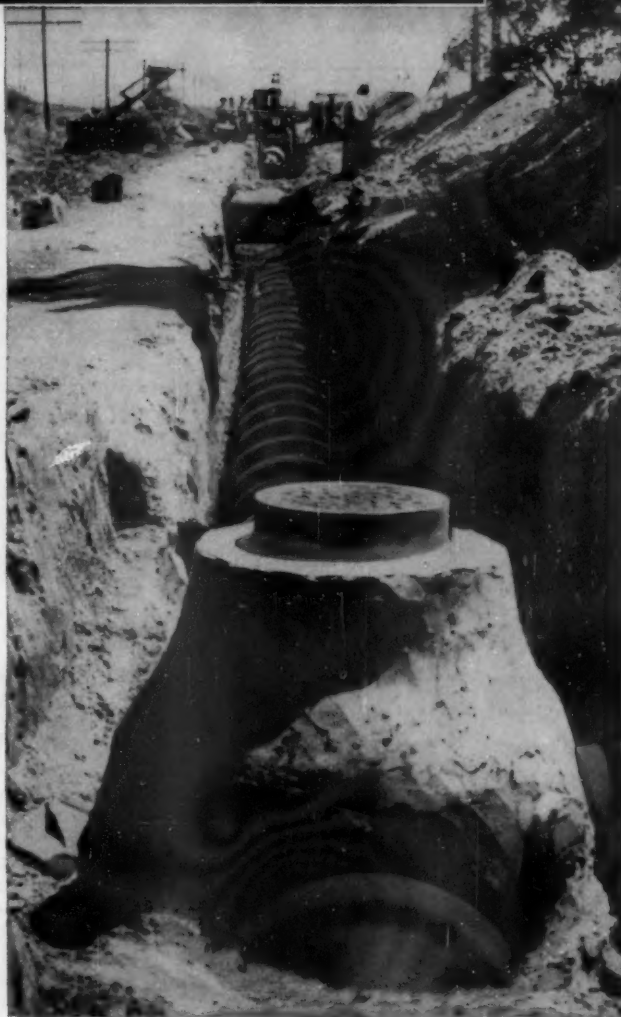
City Engineer: C. M. Franklin.

Architects and Engineers: Vinson & Company.

Chief Engineer: R. M. Breen.

Resident Engineer: W. R. Peck.

Contractor and General Supt.: Howard T. Barry.



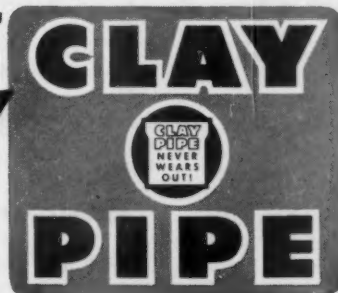
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C-056-4



PUBLIC WORKS DIGESTS

THE HIGHWAY AND AIRPORT DIGEST

Precast Concrete Bridge Units

Since 1952 the Arkansas Highway Dept. has been using precast concrete decks in constructing and reconstructing its bridges; also precast pile caps and guard rail posts. The standard units now being manufactured are 3 ft. 6 in. wide (some special ones 2½ or 4 ft.) and 31 ft. long. Until recently the standard length was 19 ft., but it was found that the longer ones could be built with identically the same cross-section as the shorter ones by using high-strength stressed steel bars, post-tensioned to permit a design that will carry an H20 loading. Concrete is used which has a compressive strength of 3,000 to 4,000 psi in 24 hours. The cost of a 31-ft. span is approximately \$4.00 per sq. ft. for a deck alone.

"Precast Bridge Units Save Time and Reduce Cost." By E. F. Bespalow. *Civil Engineering*, November.

Thin Bonded Concrete Overlay

During the summer of 1954 there was laid, at Selfridge Air Force Base, Michigan, 45,000 sq. yd. of thin bonded concrete resurfacing on an old concrete pavement, using a recently developed technique. The contract called for a nominal thickness of 1½ in. and a minimum of 1 in. It was awarded at \$3.49 per sq. yd. The first step in the construction was to plow out all the jet fuel-resistant sealer used in the joints. Then the old pavement was scarified to a depth of ½ to ¾ in. to remove loosened surface material and any spots of bitumen. The pavement then was washed with a detergent to remove all oil or other foreign matter, and etched with muriatic acid applied by a tank truck, using 1 gal. per 100 sq. ft. When the action of the acid had stopped, the surface was thoroughly flushed with water. While the surface was damp but held no free water, a grout of 1:1 portland cement and sand having the consistency of heavy paint was applied and brushed in thoroughly to a coating 1/16 to 1/8 in.

thick. Before this became dry, the concrete surface was applied. This consisted of 40% dolomite limestone with maximum size of ½ in. and 60% concrete sand, and 7.6 sacks of cement per cu. yd., with Darex air-entraining agent producing 7 to 8% of entrained air. The surface was finished with a Blaw-Knox double screed finishing machine traveling on wooden side boards bolted to the concrete, leveled off with 10-ft. straightedges, and finished with a burlap drag. Transverse expansion joints were formed exactly above those in the original concrete.

"Thin Bonded Concrete to Overlay Pavement." By Hubert C. Persons, Contributing Editor. *Roads and Streets*, November.

Cement for Patching Concrete

California's highway department, after laboratory and field experiments during the past two years, have decided that Epoxy-thikol cements are excellent for concrete repairs which require cementing fresh concrete to old, as in making patches, sealing cracks, or adding a thin layer of new concrete to old. In the laboratory, the two halves of a 6 x 6 in. concrete beam which had been broken in the testing machine were cemented together and the beam tested again, when it broke in a new place. A 2 x 4 ft. section of defective concrete pavement was cut out, the edges covered with this cement and the hole filled with high early strength concrete, which adhered perfectly to the old concrete and was still so a year later. The same adhesion was obtained when filling potholes only ¼ in. to 2 in. deep.

"Epoxy Adhesives as Structural Repair Material." By Herbert A. Rooney and E. D. Botts. *Testing Engr's. California Highways*, July-August.

Patching Asphalt Surfaces

The Street Department of Rockford, Ill., found it difficult to do satisfactory patching of its asphalt

pavements by use of either cold-mix asphalt or hot-mix, the latter because it cooled too much while being brought from the mixer to the job. They have solved the problem by using a "Heat a Mix" unit, which is attached to a dump truck. Hot-mix asphalt is kept cold at the yard and chunks broken off as needed. About 4 cu. ft. of these are placed in the unit, where they are heated by a propane burner in a pugmill mixer, and in 3 to 5 minutes the asphalt is soft enough to use. The hole to be patched is first primed with RC or MC-4. A hand roller is used for compacting.

"Pleasing the Taxpayers With Hot Mix Patching." By Joseph P. Bruno, Supt. of Streets. *PUBLIC WORKS*, December.

Contract Maintenance In Ohio

"We in Ohio have found contract maintenance to be generally quickly completed and of very good quality, often superior; always of fair and definite cost and often unquestionably at lower cost than if done by state forces; an excellent safeguard in helping us to maintain a fixed manpower requirement and an equipment need at the lowest possible level." Five yardsticks govern the possibilities of contract maintenance: 1) The repetitive nature of an item, year after year, such as painting guard rails, weed control, joint and crack sealing, pavement patching, surface treatment, etc. 2) Adaptability of the item to unit evaluation. 3) The possibility of definitely locating all elements of an item with respect to the details of the work required. 4) Inspection. 5) The possibility of profit. In 1955 about 465 miles of roadmix asphaltic work were contracted and 850 miles of surface treatment; also 500 miles of bituminous dust laying.

For snow and ice control, contractors' equipment may be rented, but aside from this no contract work is done. Reliance on county maintenance forces is found more satisfactory.



NO. 212 "GETS THE JOB DONE"

This CAT* No. 212 Motor Grader is owned by the City of Galena Park, Texas. It is shown here cutting out old street surface to a depth of 8 inches. Then 8 inches of stabilized shell is put in and the street refinished with 1½ inches of blacktop.

With 10 days off because of rain, the machine completed the job in a month. D. J. Campbell, Street Superintendent for Galena Park, says: "We used to have a grader of another make, and the expense of upkeep just ate us up. With Caterpillar-built machines we never worry about upkeep and the fuel is insignificant. They're rugged and they get the job done."

When you're choosing a motor grader the question isn't "How big is it?" but "How much work will it do in a year?" The No. 212 is designed to fill all the needs of many municipalities. While it is the smallest and lowest-priced grader in the Caterpillar line, it's built with all the rugged stamina of the bigger machines. The dependable 50 HP Cat Diesel Engine is balanced

with weight, speed and traction to deliver a solid day's work, day after day, with practically no down time.

The No. 212 costs less to buy, less for fuel and repairs. Operators like its positive-acting power controls, easy, accurate steering, quick blade positioning and complete job visibility from the seat. New *tubeless tires* eliminate tube and flap trouble and greatly reduce tire down time, yet cost no more.

Let your Caterpillar Dealer show you how a Cat No. 212 can save your taxpayers' money. His reliable parts and service facilities stand behind your investment.

Caterpillar Tractor Co., Peoria, Illinois, U.S.A.

CATERPILLAR*

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**NAME THE DATE...
YOUR DEALER
WILL DEMONSTRATE**

"Maintenance and Routine Betterments by Contract." By C. W. McCaughney, Deputy Director. PUBLIC WORKS, December.

Directional Signing And Highway Design

In designing highway intersections, the engineer should consider the possibility of so placing the directional signs as to give clear, definite information to traffic for passing the intersection. It should be possible to provide continuity of sign routes and freeways, to allow for all 12 traffic movements at interchanges where two sign routes intersect; to avoid "pulled-apart" interchanges because of the difficulty they create in directing traffic back onto the freeway; to provide for distances between exit ramps of at least 1,000 ft., and 600 ft. between a freeway exit gore and a collector road gore; to provide adequate visibility for exit ramps and their signs; to allow for adequate gore width on rural freeways where reflectorized signs are to be used. Avoid ramps for local traffic movements within the interchange area when two freeways intersect. Provide for collector road, if feasible, when cloverleaf type of inter-

section is used. On a freeway it is desirable, because of the speed of traffic to place only one name on a sign.

"Correlation of Geometric Design and Directional Signing." By George M. Webb, Traffic Eng., California Div. of Highways. *California Highways*, September-October.

Prerequisites Of Borrow Sites

In some cases where a contract requiring provision of large quantities of borrow is to be let, a contractor sometimes practically eliminates competition by buying up all available borrow rights. To prevent this, the California Dept. of Highways makes agreements before hand with owners of suitable material to furnish it to the successful bidder; the latter does not have to buy this material, but knows beforehand where and at what price he can obtain it. The prerequisites of a good borrow site are as follows:

1. A short haul, for if the haul is too long, no matter how cheaply the material can be bought, it is still expensive material.

2. Insofar as possible, an unobstructed haul, that is, ability to haul material without using any county

road or heavy-traffic city street.

3. If possible, secure all material from one source.

4. Avoidance of grade crossings of railroads or highways.

5. Ability to remove material from the source by the use of heavy off-road earth-moving equipment. This ties in with No. 2 above.

6. Minimum land defacement.

7. Minimum number of owners with whom it is necessary to negotiate.

"Borrow Site Headaches." By J. M. Asbill, Rt. of Way Agent, and P. C. Morris, Materials Eng., Calif. Div. of Highways. *California Highways*, September-October.

Skidding and Skidding Coefficients

A study of skidding accidents made by the Road Research Laboratory of England showed that, while the frequency of them at a given site was influenced by the presence of curves, junctions, traffic circles grades, etc., it was also influenced by the skidding resistance of the surface. Where the "sideway-force coefficient" at 30 mph was 0.6 or greater, there were few skidding accidents. Where the coefficient was 0.5 to 0.6 there were few accidents

New Wain·Roy BACK HOE for PAYLOADER Models HU-HH



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Wain·Roy CORPORATION Hubbardston, Mass. Dept. C

except at bends with very fast traffic; under which conditions there were more accidents if the coefficient was 0.4 to 0.5; and where the coefficient is below 0.4, accidents occurred even on straight roads, unless the speed was very low.

"Skidding Resistance of Roads."

By C. C. Giles, of Road Research Laboratory. *The Surveyor*, Oct. 27.

Prestressing Slabs Off the Ground

Experiments have been conducted in England in prestressing concrete runway slabs while elevated above the ground. When a slab is prestressed while resting on the ground, the friction between the slab and the ground results in a large amount of the stress being lost in the center of the slab. A test pavement was built up of precast panels, 6 in. thick, which were lifted by vacuum suction pads onto small dwarf walls projecting about $\frac{3}{4}$ in. above a prepared base. The stressing wires were then threaded through ducts which had been formed at 3-ft. centers in both directions and stressed. Then both the cable ducts and the space beneath the slab were grouted with a colloidal grout pumped in under pressure. It is believed that the resulting pavement will support an unlimited number of applications of a 50,000 lb. load on a 12-in. plate.

"Prestressing Runways Off the Ground." *Highways and Bridges*, Oct. 24.

Frost Susceptibility In Soils

Research work was conducted last year on the influence of fines content on frost susceptibility of an ideally graded gravel. It was learned that the ideal gravel with no fines content was still frost susceptible. But when calcium chloride was added, even in low concentrations, it was effective in preventing frost action.

"Results of Research on Frost Susceptibility in Soils." By Pierre La Rochelle, Research Fellow, Laval Univ. *Roads and Engineering Construction*, October.

Frost Heaving Eliminated by Stabilizing Base

With temperatures as low as 20° below zero, and frost penetrating 2½ to 3 ft. into the poor quality base material, there has been an excessive amount of heaving in New Mexico, and normal patching meth-

for Dust Control and Soil Stabilization



use a "Scotchman" to spread your chemicals

UNIFORM SPREAD. The "Scotchman's" 'bird shot' pattern, is specially important in dust control work. This even, uniform chemical spread not only saves material; it insures longer-lasting, more uniform results. For soil stabilization work this uniform spreading pattern is equally important. It gives you a more thorough mixing of chemical with soil . . . produces a tough, hard soil pavement with no soft spots.

CONTROLS: With the "Scotchman" you have two special controls that give

you these better results: 1. accurate control of density of spread, 2. accurate control of width of spread. Application rate tables are supplied which tell you how much material you are spreading.

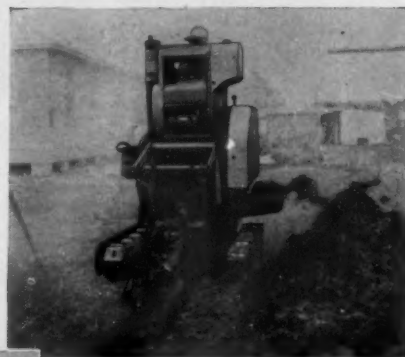
CONVENIENT: A "Scotchman" will operate from any of your trucks. Handles either bagged or bulk material. Can be quickly changed from one truck to another . . . right on the job. Because of the instant width control the "Scotchman" is especially useful for shoulder stabilization.

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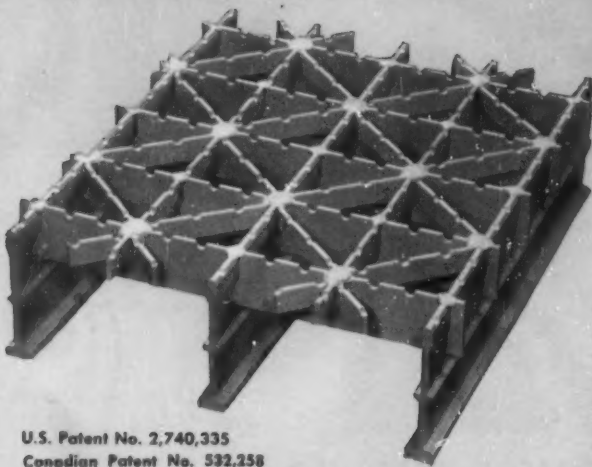
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New GREULICH 4-way GRID

Holds Installation and

Skid-resistant,
flat, serrated
surface

Bascule bridge, New Iberia,
La. Contractor: F. Miller &
Sons, Lake Charles, La.



U.S. Patent No. 2,740,335
Canadian Patent No. 532,358


Greulich 4-Way Grids

Precision manufactured. Comes out square and rigid, assuring true alignment. Will not rack.

Integrally connected triangles extend over entire roadway insuring maximum lateral or horizontal rigidity and high skid resistance. They are especially adaptable for reflooring old bridges. Solid, 5-inch deep units remain true during shipment, handling and erection. Test data available proving resistance to distortion. Grids made in lengths up to 36 feet and 7 feet 3 inches widths to reduce number of units to be handled and field splices to be made between grids.

from **KERRIGAN** is Stronger and Quieter! **Handling Costs to a Minimum**

20% Fewer Field Welds in this NEW OPEN STEEL BRIDGE FLOORING

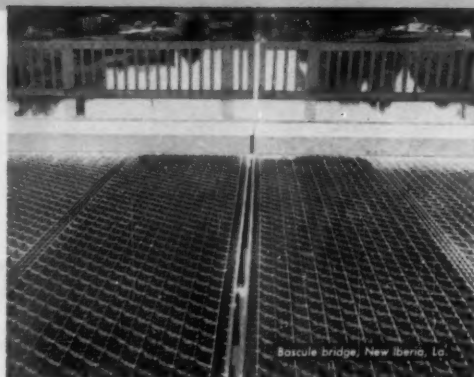


Illustrated here are several of the many Louisiana bridges recently floored with Kerrigan Iron Works' new Greulich 4-way grid. This design permits economy in field erection (without loss of strength) as main bearing members are spaced $7\frac{1}{2}$ inches apart instead of 6 inches, thus requiring fewer field welds. Units are fabricated in panels 7 feet 3 inches wide to hold handling costs to a minimum and still permit hauling on ordinary flat bed trucks. The 4-way grid provides a flat, single plane, serrated surface—gives a straight, smooth ride and reduces tire hum to a minimum. Yet, due to triangular openings and scientifically located serrations in the top surface, it provides greater skid resistance.

In order to keep traffic moving on the bascule bridge shown at left units were cut to half-width areas, then welded together to form a solid, one piece, smooth surface.

This flooring is now being produced in our large, modern production plant, and a large reserve supply of materials is on hand to insure prompt delivery. For further information, write to our bridge flooring division.

Raceland and Thibodaux
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Bascule bridge, New Iberia, La.



Thibodaux, La.



Raceland, La.

GREULICH Bridge Flooring Division KERRIGAN IRON WORKS, Inc.

Harvey F. Neel, Manager, Bridge Flooring Division, Nashville, Tenn.
General Sales Office: 274 Madison Ave., New York City

ods have proved inadequate. But for several years roads at the Wingate Ordnance Depot have been reconstructed successfully by stabilizing the base with hydrated lime. All the existing base material is used and 3% of hydrated lime worked into it to a depth of 6 to 8 in. or enough lime to reduce sufficiently the plasticity index, which in some places ranged from 12 to 22. In construction, the existing bituminous surface is bladed off, the base is pulverized for a width of 16 ft. and the lime is distributed and mixed by windrowing back and forth, leveled and rolled with sheepfoot and

smooth rollers. The roads have remained satisfactory after five years.

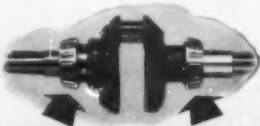
"New Mexico Road Reconstruction Project Eliminates Frost-Heaving Damage." By John Sipe, Deputy Post Engr. *Better Roads*, November.

Other Articles

"Zoning at the County Level." Allegheny Co., Pennsylvania. By Robert L. Horne, Asst. Chf. Eng., Bureau of Projects and Surveys. *Public Works*, December.

"Monuments on Right-of-way Lines of County Roads Pay Off" at 1,000-ft. intervals in Ocean Co., N. J. By Lawrence F. Wagner, Co. Eng. *Public Works*, December.

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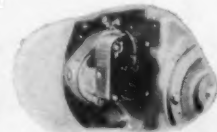
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True quality depends on 2 points . . . mower performance and power performance. Points recognized by manufacturers who build mowers that are meant to deliver continuous, heavy-duty mowing service. These manufacturers and their customers know the value of the superlative Wisconsin Engine features shown here . . . all contributing factors to the finest long-term mower performance. Write for handy Service Map, S198.

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"Special Equipment in a County Highway Department" developed by combining various pieces of stock equipment. By North H. Newton, Co. Eng., Champaign Co., Ohio. *Public Works*, December.

"The Work of the Road Research Laboratory" of England. Report for 1955 on bituminous paving. *Roads and Road Construction (England)*, October.

"Factors Affecting Road Capacity;" speed, percentage of trucks and buses, curvature, grades, intersections, peak traffic, etc. By J. G. Wardrop, of Road Research Lab., and J. T. Duff, of Ministry of Transport. *Surveyor*, Oct. 20.

"Assessing Traffic Requirements." By H. M. Edwards, Asst. Prof. of Civil Eng., Queens Univ. *Roads and Engineering Construction*, October.

"Skidding Resistance of Roads" depends largely on the aggregates used. By C. G. Giles, of Road Research Laboratory. *Highways and Bridges (England)*, Nov. 7.

"Planning for Snow and Ice Removal." A Forum article. *Better Roads*, November.

"Accelerating Production in Highway Engineering Work" by use of electronic equipment and other engineering aids. By H. A. Radzikowski, of B.P.R. *Better Roads*, November.

"Improving County Highway Administration" in Indiana, Recommends cooperation. By John E. Stoner, Prof. of Govt., Indiana Univ. *Better Roads*, November.

"Do We Need Additional Toll Roads Now?" The writer thinks not. By Louis Tonti, Exec. Dir., N. J. Highway Authority. *Better Roads*, November.

"How Airphoto Interpretation Can Speed Highway Planning and Design," a field separate from photogrammetry. By James G. Johnstone, of Geophoto Service. *Roads and Streets*, November.

"When Should Your Equipment Be Replaced?" By R. L. Peurifoy, Prof. of Constr. Eng., Texas A&M College. *Roads and Streets*, November.

"The Problem of Construction Plans and Specifications." By Richard A. Haber, Chf. Eng., Delaware State Hwy. Dept. *Civil Engineering*, November.

• • •

Sewerage Requirements for Subdivisions

An ordinance has been upheld for Marple Township, Pa., which provides that real estate developers must construct sewers in new subdivisions. These sewers are capped at the points where they will meet trunk lines to be extended later by the township. When the trunk lines are not available, the subdivider must provide each house with an individual septic tank to be used until the trunk line system is installed. The ordinance was adopted to provide sewer installations at the time of subdivision and yet give the township sufficient time to extend trunk lines later as money becomes available.



City of Denver installs new **P&K** aluminum signal supports to help move increased traffic

Expanding industrialization and increased population has necessitated a new traffic signal program to keep traffic moving through the city. When completed, Denver will have a control system capable of safely handling today's traffic . . . *as well as tomorrow's.* Denver is planning ahead!

Modern lighting and vertical "over-the-road" signals are supported by new P & K aluminum shaft extensions and truss mast arms.

The use of these new P & K designs results in high signal visibility even against neon-lighted backgrounds and in congested areas. Great strength, easy installation and no painting or maintenance problems make these P & K units low in *real* cost.



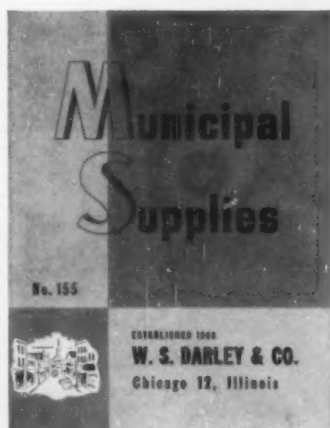
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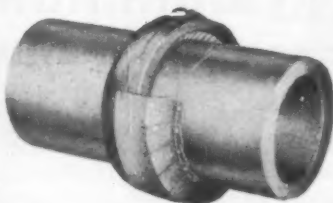
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Data on NERVE GAS POISONING

THE NERVE gases are a group of highly toxic organic esters of phosphoric acid derivatives which have physiologic effects attributable to the inhibition of cholinesterase enzymes. The effects resemble those produced by physostigmine and neostigmine (Prostigmin), but are more intense and more prolonged. The nerve gases are among the most toxic of the chemical warfare agents, and they are the most adaptable to long-range attack, as upon civilian populations. A number of related, but somewhat less toxic, organic phosphate anticholinesterase compounds have proved to be useful in medicine and in agriculture. Parathion, bis(monoisopropylamino)-fluorophosphine oxide (Mipafox), hexaethyltetraphosphate (HETP) and TEPP have been widely used throughout the world as insecticides and their indiscriminate dispersal has resulted in a number of instances of poisoning—some of them fatal. The symptoms of poisoning by these compounds are similar to those of the nerve gases, and the measures recommended for the management of nerve-gas poisoning are also recommended for the management of poisoning due to other organic phosphate anticholinesterase compounds.

The nerve gases include sarin (isopropyl methyl phosphonofluoridate); tabun (dimethylamidoethoxyphosphoryl cyanide); and several other organic esters of phosphoric acid derivatives. The effects of nerve-gas poisoning have been observed in man following exposure to sarin. It is believed that the effects of tabun and of the other nerve gases would be, in general, similar to those of sarin.

The nerve gases are colorless to light brown liquids, most of which are volatile at ordinary temperatures. While some have a faint sweetish fruity odor, this is not sufficiently intense or distinctive to enable detection under field conditions. They react slowly with water and rapidly with strong alkali, yielding hydrolysis products which are either nontoxic or less toxic than the agents themselves. Following a single bomb burst or spray, some of the nerve gases persist in toxic concentrations for many hours while others persist only until the cloud has been dissipated, usually within about 10 minutes.

The nerve gases may be absorbed through any body surface. When

dispersed as a vapor, spray, or aerosol, or adsorbed on dust, they are readily absorbed through respiratory tract or conjunctivae, while liquid nerve gases or solutions may be absorbed through the eyes, skin, or gastrointestinal tract. The nerve gases produce local effects on the tissue through which absorption occurs, particularly on the respiratory tract and eyes, and, if absorption is sufficiently great, this is followed by generalized systemic effects. The respiratory tract is the most rapid and most complete of these routes of absorption.

Local ocular and respiratory effects begin shortly after exposure and before there is any evidence of systemic absorption. After 15 to 20 times the minimal symptomatic exposure, the effects become alarming and all unprotected persons are seriously incapacitated. Mild systemic effects generally last for several hours. Moderately severe symptoms persist for 6 to 24 hours and then diminish gradually over a period of 1 to 6 days. During the period of recovery, symptoms may recur intermittently, especially following exertion. The lethal exposure, in the absence of treatment, is estimated to be approximately 30 to 50 times the minimal symptomatic exposure.

If exposure to many times the lethal dose of nerve gas has occurred, or if treatment has been too long delayed, death may occur in spite of efforts to save the patient. This emphasizes the importance of prompt masking and of prompt institution of treatment. If recovery from nerve-gas poisoning occurs, it probably will be complete.

These data are abstracted from material in the *Navy Medical News Letter* which was based on an article by D. Grob in the *Archives of Internal Medicine*.

• • •

Highway Fatalities and Births

The Garden State Parkway completed on July 1st its first 12 months of full operation with a highway record of vital statistics — only 13 traffic deaths and 6 births. There was only one multiple-death accident and two people lost their lives in that mishap; seven of the 12 fatal accidents during the year were one-car mishaps. Drowsiness of the driver or excessive speed were predominant factors in the fatal accidents.

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AMERICAN METERS *Have Longer Life*

Many American Meters in operation for 30, 35 years or more are still giving dependable accurate service. American Meters built today are so greatly improved that we know their period of service will be even longer. How much longer is difficult to estimate. It will depend entirely on the chemistry and the pH of the water to be measured and whether or not the metallurgy of the

meter components has been tailored to meet the requirements.

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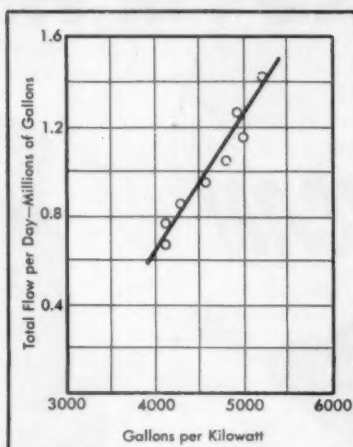
Sewage Pump Efficiency Varies with Volume of Flow

THE AVERAGE daily volume of sewage received at the Escanaba, Mich., sewage treatment plant for the 10-year period, 1947 to date, has been tabulated and compared with the electric power consumption. A. C. Christensen is Supervisor, Water and Sewage Treatment; the data was sent us by Russell L. Johnson, Engineer in Charge, Northern Peninsula Office, Michigan Department of Health, Escanaba. A. V. Aronson is City Manager of Escanaba.

Two sets of tabular data were used to prepare the accompanying chart. The first was the record of daily sewage flow each month since 1947. The second was a table of power consumption showing average KW used per day for the same 10-year period. The two tables have been used to prepare a third one showing pump efficiency in terms of the number of gallons of sewage pumped per KW of power consumption.

Arrangements of these data, with medians computed for each group of flows shows that (1) pumping efficiency is apt to depend on the volume handled; and (2) the efficiency rises steadily with an increase in the sewage flow.

These data, when so arranged, can be of special value in detecting and accounting for intervals of sub-



● SEWAGE pumping efficiency at a lift station in Escanaba, Michigan.

normal pumping efficiency. In Escanaba, it appears that there was such a subnormal period during several months between August, 1951, and July, 1952. Similarly, the data could be useful in comparing results and efficiency, at two or more pumping stations. There is always the possibility of much value accruing to a municipality from keeping accurate records of flow and power consumption; and when these indicate it, pumps should be checked and either replaced or brought up to date by impeller or other changes.

Standby Electric Power Necessary for a Turnpike

ELECTRIC POWER is so necessary in the operation of the Ohio Turnpike, which runs for 241 miles between the Indiana line and the Pennsylvania boundary, that

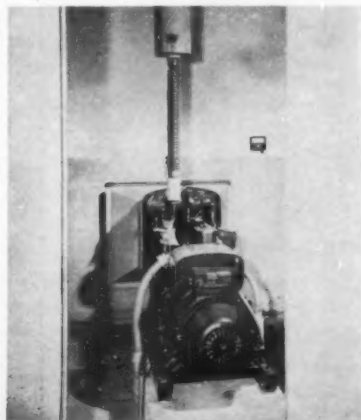
standby electric plants are installed at 26 points on the road, including both terminals, to take over in case of failure of the regular power supply serving them.

The need for standby facilities becomes evident when it is realized how many functions electric power is called on to perform on the Ohio super road. Electric power is essential for the floodlighting of 17 interchange areas at night to insure safe movement of traffic through the complexes of entrance and exit roads. Sixteen service plazas similarly must be lighted to guard against accidents as cars enter or leave them.

Electric power is required to operate machines used in collecting tolls and issuing tickets. Scales for weighing trucks to fix toll charges are equipped with electrically operated recording devices. Electric power is necessary for the operation of short-wave radio used to communicate with highway patrol cars and the fleet of emergency repair vehicles which protect and assist motorists. The turnpike's well water system is operated by electric pumps. Electrically powered blowers are used on the heating systems of the buildings. Maintenance shops are equipped with electrically driven tools, and of course electricity is used at all points for general lighting.

With so much dependence on electric power, any interruption in the regular source could obviously cause confusion. This problem is solved on the Ohio Turnpike by standby electric plants which automatically take over.

The 26 standby plants on the turnpike, 25 of which are Kohler, are each of 15 KW capacity, enough to serve all the needs of the turnpike during an emergency. Each plant is equipped with an automatic transfer switch which cuts in at the moment of power failure and provides the needed power within seconds.



● TYPICAL 15-kw Kohler electric plant, in use at Warren interchange.



● ELECTRICITY is vital for operation of interchange and service plazas on the Ohio Turnpike. To insure power, standby electric plants are installed at 26 points.



How HAPCO Poles cut maintenance on the New York Thruway...

When the New York Thruway planners specified HAPCO Aluminum alloy lighting standards for the Tappan Zee Bridge, they specified the end of pole painting maintenance. For this most concentrated over-the-water lighting installation in the world posed a major maintenance problem due to its exposure to great amounts of moisture.

Solving the problem with 220 HAPCO tapered Aluminum Poles and 35 special HAPCO Lighting Brackets for mounting on the middle span was a no-maintenance investment. That's because HAPCO Aluminum Poles and Brackets are corrosion resistant. They require no initial or maintenance painting. Maximum structural strength is assured because HAPCO Poles are spun from Aluminum Alloy and Heat-treated. Their silver grey beauty blends with the most modern surroundings,

provides the highest visibility for maximum safety.

What's more, HAPCO Standards are designed to fit your individual requirements. Your Hubbard representative will be glad to assist you in specifying the HAPCO Pole that exactly fits your needs. And they're available from more than 300 leading electrical distributors throughout the United States.



Free HAPCO Catalog

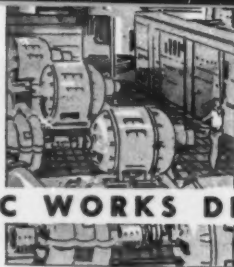
If you'd like more details on design features and specifications of the complete Hapco line, write for catalog HAL 754. It contains valuable information to help you plan the most efficient, most beautiful highway and street lighting, as well as any other outdoor lighting requirement. (Hubbard Aluminum Products Company, 6301 Butler Street, Pittsburgh 1, Pa.)

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PUBLIC WORKS DIGESTS

THE WATER WORKS DIGEST

Financing Extensions for Subdivisions

Old consumers should not have to pay, through increased rates, for extensions to new subdivisions. So Dallas, Texas, in 1954, adopted a policy whereby developers would pay the total cost of their water systems and sewer systems, the city sharing only in the cost of incremental or oversized lines above a minimum of 8 inches in size. The income from the new customers, over and above operating expenses, is applied to the cost of additional plant and transmission facilities. It was found that the average overall cost per lot for water and sewerage for 87,000 new connections since 1945, including new plants, lines and reservoirs, amounted to \$982. For water only, the on-site costs were \$315.28, and the off-site costs were \$271.27. Many cities fail to consider the off-site costs in calculating the financing of new connections and the income which should be derived from them. The author explains how these ideas are embodied in their fixing of rates and other financing.

"Money Makes Water a Problem." By Henry J. Graeser, Supt. PUBLIC WORKS, December.

Reservoir Roof of Prestressed Concrete

In constructing a roof for the 5 mg service reservoir at Higham, England, the number of supporting columns was reduced to a minimum by using precast prestressed concrete infilling cast in place. The roof is 296 ft. 9 in. by 156 ft. 9 in. Fifty precast columns were used to support it. The surrounding walls were of mass concrete, built in 27-ft. sections, with rubber water stops at the joints, with several expansion joints. The main roof beams span 27 ft. 3 in., and the secondary beams span 26 ft. 2 in. at 2 ft. 3 in. centers. The main beams were post-tensioned after the secondary beams

were in position, using a tensioning force of 81.5 tons. The beams are of I-section, the main beams 25 in. deep, with a top flange width of 14 in. and bottom flange 18 in.; the secondary beams are 12 in. deep with flanges 6½ in. and 9 in. wide. Spaces between secondary beams were filled with aerated concrete with a density of 70 lb. per cu. ft. Aerating the concrete made it a better thermal insulant than normal concrete. Further insulation was provided by a 2-in. blanket of aerated concrete over the entire roof, which weighs only between 2 and 3 lb. per sq. ft. This was water proofed by a 1-in. layer of dense concrete. The design was calculated for a snow load of 30 lb. per sq. ft.

"Service Reservoir With Prestressed Concrete Roof." *The Surveyor*, Oct. 13.

Master Plan For a Water District

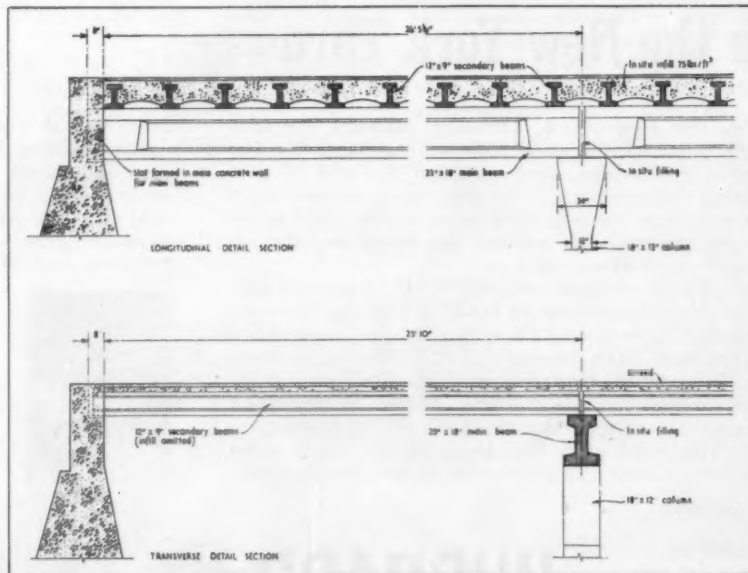
The importance of a long range planning procedure in developing a water works system in order to secure both good engineering and a

sound financial structure was demonstrated by the preparation of such a master plan for a water and sanitation district near Denver, Colorado. The master plan had five major headings—general water data; program of water supply development; annual income; annual expenses; and use of funds for capital expenditures required. One result of the adoption of this plan has been that many buyers of quantities of municipal bonds have expressed an unusual interest in such a plan and reduced interest rates on such bonds.

"Developing and Financing Water District Master Plan". By V. A. Vaseen, Consulting Eng'r. *Water Works Engineering*, November.

Upflow Clarification Of Water in England

A population of 195,000 near London, England, is supplied from the Thames river, which carries considerable sediment. Until recently the treatment of this water consisted of primary filtration through two batteries of rapid



● RESERVOIR roof details showing method of using prestressed concrete beams. Courtesy The Surveyor

WATER WASTE

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ROCKWELL WATER METERS

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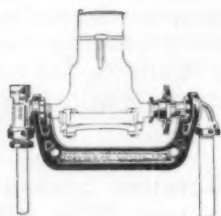


gravity filters; secondary filtration through slow sand beds; and sterilization by break-point chlorination, followed by the removal of excess chlorine with sulfur dioxide. This treatment allowed water bearing a relatively high content of suspended matter to reach the primary filters, reducing the period between cleaning of the rapid filters to as low as fifty minutes, which required the use of large amounts of wash water. Four years of experimenting with a pilot plant led to the construction recently of a new plant using upward-flow sedimentation and the use of sulfate of alu-

mina and modified sodium silicate as reagents. The new plant consists of twenty vertical flow-type sludge blanket tanks with hopper bottoms, located between the river and the existing rapid filters, with a total sedimentation area of 12,500 sq. ft. Coagulants are introduced into the raw water before it enters the settling tanks. The use of 20 ppm of sulfate of alumina and 2 ppm of modified sodium silicate is found to give satisfactory results. The period between washings of the primary filters now is never less than 50 hours. The new sedimentation tanks have a capacity of 9.5 mgd.



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"Upflow Clarification of Thames Water by Alum and Silicate Coagulation". By John Grindrod. *Water Works Engineering*, November.

Leak Proofing A 100-Acre Lake

The Corps of Engineers has leak-proofed a 100-acre lake near Denver, Colo., by means of an asphaltic membrane. The asphalt used is the last residue of the distillation of normal asphalt base petroleum. A catalyst blown into it produces a chemical change that results in a very tough, rubbery membrane that adapts itself to contours of the surface to which it is applied. In placing the asphalt, a wide strip was excavated to grade and compacted to a smooth surface. Preheated asphalt was distributed through a spray bar placed as an outrigger at one side of the distributor instead of at the rear. A strip, 12 ft. wide and 1,000 ft. long was covered in three successive applications, using 1.35 to 1.50 gal. per sq. yd. This was then covered with an earth blanket one foot thick, to within one foot of the edge of the membrane, which was left uncovered to provide an overlap of the next strip. This edge was blown clean by means of an air compressor, and the next strip of membrane was applied in the same way, overlapping the first strip by 4 to 6 in.

"Asphaltic Membrane Is Used to Leakproof a Lake". *Engineering News-Record*, Nov. 22.

Toxicity of Certain Algicides

The Robert A. Taft San. Eng. Center has been studying the toxicity of various chemical compounds which might be used as algicides. Six chemicals were found to give promise for use for this purpose, including copper sulfate. The toxicity of each of these to 30 cultures of algae and also to fish was studied and the result of the study is given in detail in this article. All six exhibited some degree of selectivity to the various species of algae tested. In considering both algal and fish toxicity, two were found to be quite toxic to fish. One is selectively toxic to some of the blue-green algae. Copper sulfate appeared to be selective rather than general in its algicidal effects when used at concentrations of 2 ppm or less.

"Toxicity of Six Chemical Compounds To Thirty Cultures of Algae". By Thomas E. Maloney and C. Mervin Palmer, of the Robert



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● Lagging distribution pressures during peak load periods plague many communities, especially in the summer-time. This problem can be solved by a modern Horton® elevated tank, such as the 300,000-gal. tank at left, built for Bremen, Indiana. A Horton elevated tank stores a reserve of water that flows by dependable gravity pressure to meet peak load periods and smooth out pressure variations throughout the distribution system . . . resulting in better, more reliable water service to consumers.

Horton elevated tanks are built in sizes to 3,000,000 gallons. Write our nearest office for further information on how a Horton elevated tank can solve *your* distribution pressure problems.

Above: 300,000-gal. Horton ellipsoidal bottom elevated tank erected at Bremen, Indiana. Plates for the tank were pickled and painted, using the Horton Pickling Process, before shipment from CB&I's plant.



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Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PA.

A. Taft Center. Water & Sewage Works, November.

Developing a County-Wide System

The Spartanburg, S. C., Water Works is carrying out a \$7 million expansion program in order to provide water for the entire rapidly developing county. The present capacity is 12 mgd, and will be 15 mgd by February, 1957. During the past two years, 7 water districts were created in the county, each of which elected to purchase water from the Spartanburg water works rather than create its own

facilities. Each district is responsible for the construction and maintenance of its own water lines. Each district finances its system by issuing general obligation bonds, repayment of which will be made from revenues received by the district for retail water sales, supplemented by a special tax levy on real property.

"Spartanburg's Water System". By R. B. Simms, Supt. PUBLIC WORKS, December.

Other Articles

"Unaccounted-for Water Losses Held to Minimum by Meter Maintenance" in

Los Angeles. By R. E. Hemborg, Eng. of Water Distribution. Water Works Engineering, November.

"Present and Future Estimated Rates of Water Consumption," as reported by a number of consulting engineers, water works managers and other officials, and state sanitary engineers, tabulated and analyzed. Public Works, December.

"Weirton Mill Makes More Steel and Requires Larger Water System." By Charles W. Granasher, Project Eng. Water Works Engineering, November.

"Iron Removal—Softening Treatment Corrects Red Water and Hardness" at Mount Gilead, Ohio. By R. J. Boes and R. E. Peters, Cons. Engrs. Water Works Engineering, November.

"Legal Aspects of Water Fluoridation." By John H. Murdoch, Jr., Chf. Counsel, Am. W. W. Service Co. Water & Sewage Works, November.

"Disinfection—Chlorination Practices; Other Disinfection Methods." By George E. Symons. Water and Sewage Works, November.

"Concentric Orifice Diameters" for water meters. By Alexander Goldstein, Mech. Eng., Chicago San. Dist. Water and Sewage Works, November.

"Management Reorganization of Philadelphia Water Department" under a new charter adopted in 1952. By Samuel S. Baxter, Water Commissioner. Jour., AWW Ass'n, October.

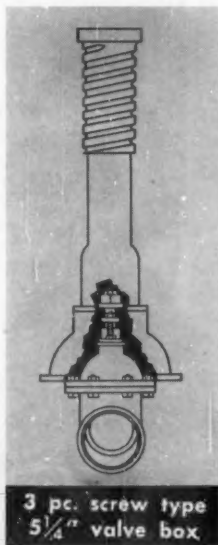
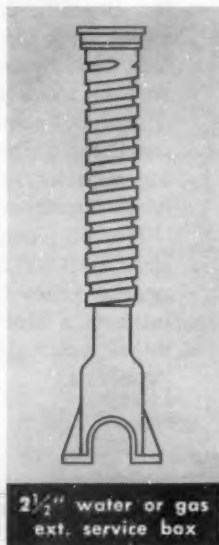
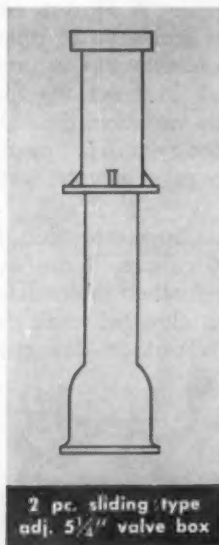
"San Juan, Puerto Rico, Newest Water Supply." Dam, hydroelectric plant and sanitation of the watershed. By Rafael B. Urrutia, Director. American City, November.



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Dr. Abel Wolman to Speak at Beaver Dinner Meeting

Dr. Abel Wolman, professor of sanitary engineering at Johns Hopkins University, former president of the American Water Works Association, holder of several degrees and member of a host of industry committees, including the Atomic Energy Commission and the Pan American Sanitary Bureau, will be the featured speaker at the second annual awards dinner of The Beavers to be held January 17 at the Biltmore Hotel in Los Angeles.

Nearly one thousand Beaver members are expected to attend the dinner at which special awards for outstanding contributions and meritorious service to the heavy engineered construction industry will be presented.

The event marks the second annual meeting of virtually all the prominent heavy engineered construction men west of the Mississippi. The Beaver organization was first formed in the spring of 1955 primarily as a social organization and to honor American contractors who exemplify the skill and venturesome spirit of the industry.

Radio Coordinated Traffic Lights

INSTALLATION of radio traffic controls which will result in savings of approximately \$100,000 will begin in January along a 2½ mile section of the Middlesex-Fells Parkway in the Boston Metropolitan area.

The units, to be placed along the Parkway in the Medford-Malden area, are the first to be used in New England. Charles W. Greenough, Metropolitan District Commission Chairman, says "Coordination of traffic lights by radio will make a major contribution in expediting the flow of vehicles north of Boston when work on the Parkway is completed." The use of radio controls will save the commission the cost of laying cables for the 2.65-mile stretch of highway.

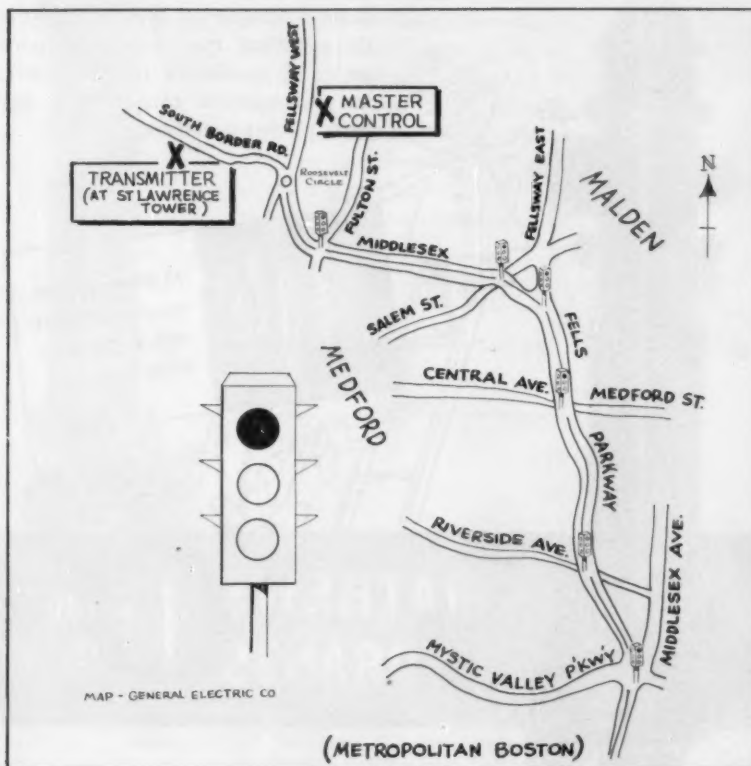
With buses having replaced streetcars which formerly traveled the route, a 32-foot strip in the center of the Parkway, formerly used by streetcars, has become available to the Commission for road-widening purposes. When completed the road will have six lanes, with a 10-foot center strip. Parkway reconstruction has been underway for six months.

General Electric intersection units will be installed on the Parkway

beginning at the point where a channelized intersection joins together Mystic Valley Parkway, Revere Beach Parkway and Middlesex Avenue. Other intersections along Middlesex-Fells which will have radio controls include Riverside Avenue, Central Avenue and Medford Street, Fellsway East, Salem and Pleasant Streets and Fulton Street.

The base station, antenna and tone translator for the system will be at Lawrence Tower on South Border Road, and the master controller will be at a police station a short distance away on Fellsway West. The operation of the system will be the responsibility of the Parks Division of the Metropolitan District Commission. As a result of radio controls, cars traveling at a speed of 35 miles an hour should be able to go the whole length of the new section from Wellington Bridge to Roosevelt Circle, without stopping.

The timer will be connected to the Lawrence Tower transmitter by a wire line and from that point tone signals will go out by short-wave radio to activate the traffic lights at each of the six intersections equipped with radio coordination units.



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Sewerage and Sewage Treatment in New Zealand

A REVIEW OF SEWAGE treatment processes and practice overseas and in New Zealand has been prepared by R. C. Lough, Designing Engineer, Ministry of Works, Wellington, N. Z., for the Pollution Advisory Council. Though New Zealand has not, as yet, progressed very far in the provision of modern sewage treatment plants, the presentation of data by Mr. Lough is excellent. The material that follows is abstracted from that portion of the report relating to New Zealand conditions.

Sewerage—From data collected in 1951, supplemented by additions of installations known to have been made since then, it appears that there are 43 places of more than 3,000 population with sewer systems; and these systems serve about 990,000 people, or about 75 percent of the population of those communities. There are 41 systems serving 73,000 population in towns of less than 3,000 population. Most of the sewerage systems are of the separate type, but combined sewers exist in the older parts of Auckland and in some smaller communities.

Sewage and Stream Flow—In the 1951 data, no more than six cities reported data on BOD and Suspended Solids, so that there are few reliable data as to strength on which to base design. Recognizing this fact, the Ministry of Works has allocated \$1000 for a cooperative investigation with two local authorities to determine BOD, SS and volume of flow of sewage from residential areas.

Sewage flow, in gallons per person per day, were reported by a number of communities. In Auckland Metropolitan District, per capita dry weather flow was reported at 65 gpd; wet weather flow at 120 gals; and water consumption at 70 gals. Christchurch reported 40-50 gals. domestic sewage and 58 gals. of water use. The figures for Wellington City were 62 gals. for sewage flow and 80-85 gals. for water use. Nine towns of less than 10,000 population reported an average sewage flow of 61 gals. per person per day; and 15 in the same population range reported an average water consumption of 55 gals. The range in the 10,000 to 25,000 population bracket is not much different.

The raw sewage strength reported ranged mostly from 150 to 300 ppm BOD. Auckland reported 180 ppm in summer and 280 ppm in the winter; Christchurch 176 ppm; Lower

Hutt 130 to 450 ppm for 8-hr. day-time sampling; Palmerston North 105 ppm; Petone 150 to 230 ppm; and Mosgiel, which receives woolen mill wastes, 400 ppm.

Information is being collected on the low summer flow of streams adjacent to sewerage works.

Treatment—Of the 84 sewerage systems, some treatment is provided in 57, as follows: Septic tanks to sea 5; septic tanks to inland waters 42; older septic tanks and trickling filters 5; septic tanks and sewer

forms 1; Imhoff tank 3; and complete treatment 1.

Sewage treatment works are proposed or under construction by 18 communities, and possibly more. From inadequate data, an attempt has been made to estimate the overall program of sewage treatment work likely to be required during the next 20 to 30 years. A rough estimate involves 102 towns and a cost of £8,100,000. The list includes four sea outfalls, not involving treatment; 49 primary treatment plants; 12 intermediate treatment plants; and 37 plants providing complete treatment.

The name MATHEWS means the

THE MATHEWS MODERNIZED HYDRANT

The hydrant with the *replaceable* barrel. A Mathews broken in a traffic accident can be repaired in less than half an hour by inserting a new barrel without *excavating*. In addition this high-quality hydrant is very simply constructed. It is the *dry-head* type which functions under all conditions, because water, ice and sediment cannot reach key parts to clog operation.



Sewage Treatment for Government Facilities—In addition to the municipal installations previously discussed, there are about 60 plants at such government communities as mental hospitals, Air Force, and Army camps, Power and Radio Station villages and Tourist Department Hotels. Of these, six discharge to town sewer systems; one furnishes complete treatment with intermittent sand filters; there are 12 trickling filter installations and three primary treatment plants with separate sludge digestion. In the remaining 37, Imhoff tanks number 13 and septic tanks 24. Many of

these installations are small, serving from 100 to 500 persons.

Operation and Training—Consideration has been given to the need for well-trained operators in the future and the author has estimated the personnel requirements for the various sizes of plants and the methods of treatment. A training and promotion plan, with suggested salary levels, has been prepared and is presented as an appendix. Two other factors are also considered: operating records and inspection of plant operation. The latter is planned as a system of assistance for the plant operator while insur-

ing that necessary checks are made on operation.

River Bed is used for a Motor Road

Vienna, Austria, plans a motorway in a river bed. One of three recently planned motorways will include a road on a structure 6.5 ft. above the bed of the River Wien, with feeder roads leading to existing street levels. It is reported that the river is rarely more than 3 ft. 3 ins. deep.

Sewage Pump Station Design

(Continued from page 119)

predetermined limit; at average flow the submergence must be approximately two-thirds of the screen height; minimum flows should be sufficient to distribute the load over several cutters, thus reducing the wear on the lowest group of cutters. Another basis for selection is the hydraulic head loss through the cutting screen. The loss must not be enough to cause backing up in the influent sewer. The comminutor channel discharges by free-fall into the wet well.

The comminutor must be set in a vertical position in such a manner that, at all flows, the upstream water surface will not cause backing up in the influent sewer. Once the machine is set in elevation to meet the above condition, the head loss through the screen being known, the downstream water surface level can be estimated. If, due to the free-fall condition at the channel effluent, the downstream surface level is so low as to produce excessive wear on the lowest cutters, a dam or weir is placed across the channel below the machine. The weir will then raise the water level on the downstream side of the screen and distribute low-flow wear on the cutters. In this case, a comminutor with a 25-in. screen and 3/8-in. slots is selected. The base will be set 7½ in. below the invert of the influent sewer. Downstream from the machine a 4-in. high weir will be placed to provide proper screen submergence at low flow.

The vertical shaft of the comminutor will be extended to a height of approximately 18 ft. 6 in. above the base to the motor floor where it will be connected to a vertical 1½-hp gear-motor. Output shaft speed is 11 rpm and the speed of the oscillating cutter is 11 cycles per minute. Thus the wet well may be flooded without injury to the

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THE MATHEWS FLANGE BARREL HYDRANT

Another dry-head hydrant in which the stuffing box plate is cast integral with the nozzle section. The top section of this hydrant incorporates all features of the Modernized Mathews. As an optional feature furnished at slight extra cost, it is supplied with a breakable flange and stem coupling designed to snap when struck a heavy blow. These parts can be quickly replaced without excavating.

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motor. A grit sump is provided immediately above, or upstream from, the machine.

The hand-cleaned bar screen will be fabricated of 1½-in. by 3/8-in. bars spaced 2¾ in. on centers. A drainage platform for raked screenings will be provided.

The size of the wet well is determined by the storage volume required to allow the pumps to start and stop at not-too-frequent intervals in order to permit economical operation from a wear and power cost standpoint. The wet well will be 30 ft. long and 6 ft. 6 in. wide and will have an operating water

depth of 5 ft. below the level of the influent sewer. A storage volume of 7320 gallons is thus provided. If a minimum rate of inflow of one mgd or 700 gpm is assumed, one 865-rpm pump will pump out 1600 gpm (Fig. 1) so that a net volume of 900 gpm is pumped out of the wet well. At this rate the pump will operate for 8 minutes pulling the water level down 5 ft. The time then required to fill the wet well at 700 gpm will be 10½ minutes, making the pumping cycle a total of 18½ minutes, which is satisfactory. For an inflow of 2.12 mgd or 1500 gpm and a pumping rate at

1160 rpm of 3200 gpm the pump will be on 4 1/2 minutes and off 4 3/4 minutes, a cycle of 9 1/4 minutes, which is also satisfactory.

The wet well will be covered by an exposed concrete slab with manhole and maintenance hatches provided with padlocks. The dry pit and superstructure will be heated by means of forced draft, gas fired unit heaters, thermostatically controlled. The wet well and dry pit will be ventilated for forced draft. The dry pit will be drained by a sump pump discharging into the wet well through a non-siphoning pipe line equipped with check valves.

The superstructure will cover only the dry pit and will be 30 ft. long, 17 ft. 4 in. wide and 8 ft. high on the inside. It will be built of concrete block and brick veneer walls with the roof constructed of reinforced concrete covered with built-up roofing over two inches of insulation. Windows will be steel, architecturally projected type, and the door of steel construction. Simplicity and low cost are of prime importance.

Surface treated gravel driveways will be provided for construction and maintenance purposes.

Preliminary estimates indicate the cost of constructing the complete installation will be \$68,000. No rock is anticipated in the excavation. The cost of operation of the pumping station may be estimated as follows, based on \$3.00 per hour for labor, \$0.015 per KWH and the average daily flows as tabulated above. For 3.34 mgd of sewage, labor is estimated at \$750 and power at \$2,360 per year, making a total of \$3,380. For 6.44 mgd, labor is estimated at \$1,000 and power at \$5,700 making a total of \$6,700. Materials and equipment replacement parts are not included in the above estimates.

Charges for Street Cuts

(Continued from page 142)

ton and Greenwood. In Anderson the cost is 70 cents psf and material cost, labor and time are charged in Camden.

South Dakota—The actual cost is the charge in Brookings and 50 cents psf is the cost in Yankton. Mobridge charges \$4 psy to patch oil surface.

Tennessee—In La Follette, the charge is \$5 per opening; the actual cost is charged in Kingsport, Memphis and Dyersburg. Other charges are: Springfield, \$10 to \$25; Knoxville has a fixed charge and a sur-

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charge is made on the street permits; in Ripley, the break is repaired; Shelbyville charges 60 cents psf for kyrock pavement.

Texas—The water department is charged the actual cost in Albany, Denver City, Mercedes and San Angelo. Other charges are: Dallas, cost plus overhead; Garland, cost of material plus labor; Harlingen, 25 cents psf when done by street department; Houston, dependent on size of cut; Lubbock, \$5 per lineal ft.; West University Place, cost of the material; Ysleta, \$2 psy; Corpus Christi, average \$2.85 psy; in Denison a charge is made to plumbers at \$5 psy; El Paso, \$6 psy; Midland, charge included in tapping cost; Pearsall, water dept. keeps supply of premix.

Utah—The water department is charged the entire cost in Brigham City.

Virginia — The actual cost is charged in Danville, Blacksburg and Abingdon. Portsmouth charges 75 cents to \$1 psf and Winchester's fee is \$1 per lin. ft. from the customer. In Martinsville, there is a charge of \$25 made against the customer for service; while Roanoke charges the actual bid price.

Washington—The actual cost is charged to the water department in Cheney, Kelso, Richland, Yakima, Seattle, Chehalis and Spokane. Tacoma has a charge of \$2.50 to \$3.50 psy; and in Vancouver the charge depends on type of pavement and usually runs approximately \$2.75 psy on asphaltic concrete. In Wenatchee the charge is \$15 for blacktop and the water department replaces the concrete pavement.

West Virginia—In Williamson and Wheeling the charge is the actual cost; in Princeton it depends on size of opening and cost of repairs.

Wisconsin—The actual cost is charged in Appleton, Berlin, Clintonville, Jefferson, Kenosha, Kohler, Sheboygan, Sparta, Watertown, Wisconsin Rapids, Baraboo, Kaukauna and New Holstein. Other charges are: Beloit, cost plus overhead; Berlin cost of material and labor; Hudson, depends on labor and material; Milwaukee, according to footage; Oconomowoc, varies by size of repair; Rhinelander, 35 cents psf; Wauwatosa, average cost of \$40; Ft. Atkinson has a flat charge of \$3; Marinette, depends on type of pavement; Rice Lake, charge against the property owner.

Wyoming—The water department is charged the actual cost in River-ton.

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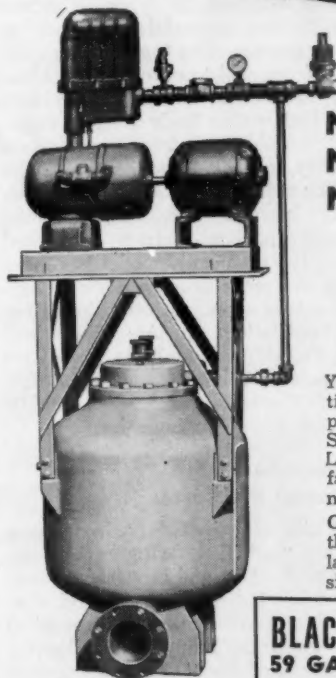
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Combined Sewage and Pickling Waste Treatment

Design of a treatment plant to handle wastes from the pickling and rolling of specialty steels at the Ingersoll Steel Division plant of the Borg-Warner Corporation at New Castle, Indiana was determined from a study of waste component flows and characteristics. The pickling wastes contributed sources of acid, in rinse water flowing 35 gpm, and occasional dumps of spent acid amounting to 2200 gallons each. Wastes from the rolling mill were discharged to scale removal pits and a reclaim sump from which the water is recirculated and reused. Overflow from this process, overflow cooling water, storm drainage, sanitary wastes, and the pickle liquor were subjected to primary treatment in a Graver Reactivator in the plant as constructed, combining flash mixing, flocculation, aeration and sedimentation. An equalizing sump with 30 minutes detention ahead of the clarifier is equipped with a Honeywell level controller which operates a U. S. Electric Motors Varidrive with Varitrol connected to the raw waste pumps. Automatic pH control for neutralization with lime is accomplished at the entrance of the flocculating zone of the clarifier. Compressed air supplied by Roots-Connorsville blowers provides mixing and assures complete oxidation and floc formation in the clarifier. Sludge is automatically discharged to lagoons.

"Industry Treats Its Sewage with Pickling and Rolling Mill Wastes." By R. W. Simpson, Gilbert Associates, and John J. Samsel, The Texas Co. *Wastes Engineering*, November.

Summary of Smoke and Smog Legislation

Attempts at ordinances regulating air pollution date back to 1864 when smoke in St. Louis was declared a nuisance, and St. Louis was probably the first large city to make an

effective reduction in smoke pollution. This was achieved in 1940 by enactment and enforcement of an ordinance prohibiting the sale of high volatile coal except in sizes under 2 inches. Through the efforts of the Allegheny Conference on Community Development, ordinances for smoke abatement were adopted in Pittsburgh with marked improvement resulting. The experiences with smog control in Los Angeles, where permits are required and plans must be approved for any equipment which may cause emission of air contaminants, have shown that the problem of urban air pollution should be attacked in its potential state rather than when it is a serious problem. The refusal to grant a power company a permit to utilize a high sulfur fuel in Southern California has resulted in the company's undertaking a \$1.75 million research program.

Federal legislation in the form of P. L. 159 of the 84th Congress was finally adopted. It is aimed at research and financial assistance to other groups. The tendency to convert from coal to oil or gas heat has helped reduce the smoke problem but high sulfur fuels are still causing trouble. Interagency (state county, and city) cooperation in the major metropolitan areas will probably become prevalent, but the county control-district patterned after the California model is generally the more popular form of enforcement agency in other localities.

"Legislation on Air Pollution." By Frederick S. Mallette, Executive Secretary, Committee on Air Pollution Controls, A.S.M.E. *Public Health Reports*, November.

Economics of Sea Disposal of Wastes

While chlorinated hydrocarbons, caustic wastes, black liquor from paper production and oily sludges may be subjected to various land disposal or reuse methods, disposal at sea where the industries are located in the Gulf Coast Area has proved to be the more economical in some

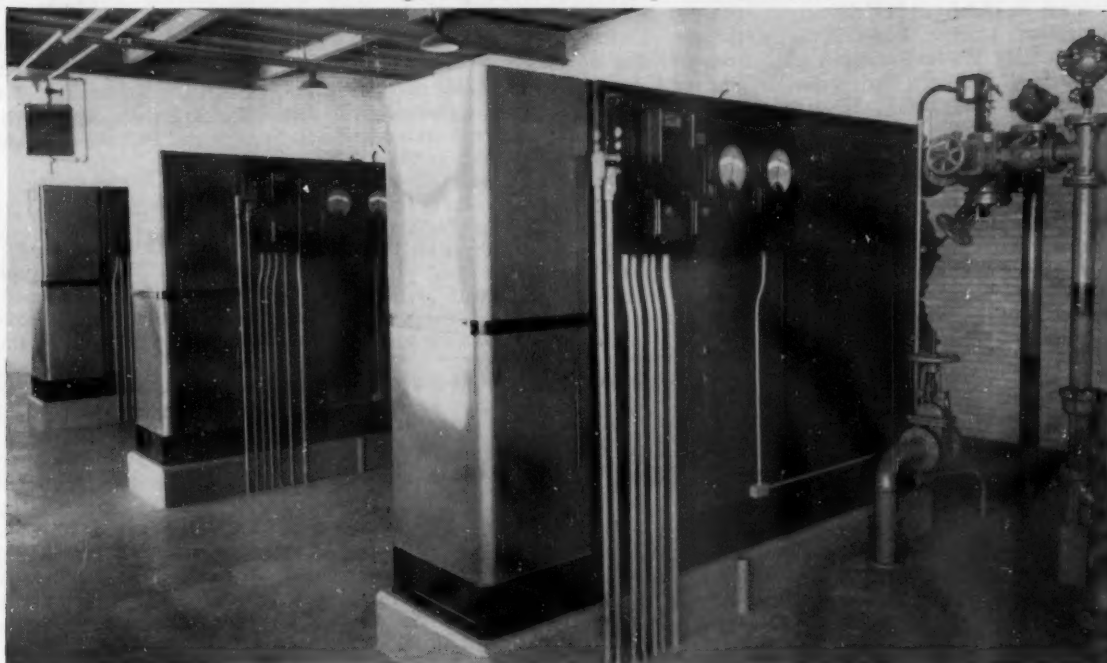
cases. Solubility of the wastes, depth of the ocean, and dispersion are factors to be considered. A waste with a solubility of 50 ppm may be discharged in sea water at a depth of 400 fathoms if the boat is constantly moving while the waste is pumped out. A barge with a capacity of 10,000 bbl. would be able to load 1500 to 1700 tons of organic chlorides. With amortization and interest, based on a 10-year life, the annual fixed charges might be \$17,000. Maintenance costs are estimated at \$800 per trip. Towing cost for a 55-hr. trip would be \$2,200 for each operation. The cost per ton of waste transported might vary from \$2 to \$3.50 depending on frequency. Steps to be taken in assuring success of the method include studying to assure absorption of the wastes without detrimental effects, advising public agencies of the action, evaluating the operation by a competent outside scientific group, and establishing the exact point of discharge with a continuous recording fathometer.

"Disposal of Wastes at Sea." By J. W. Eberman, Shell Chemical Corporation, Houston, Texas. *Sewage and Industrial Wastes*, November.

Lime Neutralization of Sulfuric Acid Wastes

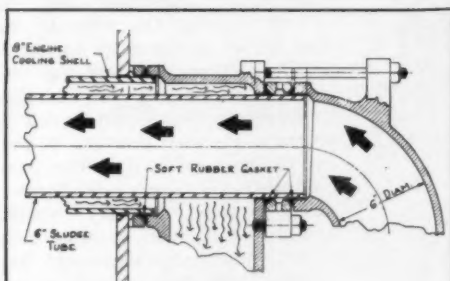
Continuation of the investigations into the cause of scale deposition after neutralization of sulfuric acid wastes was centered around factors which affect the crystal seeding process. Samples of acid solution were neutralized both in the presence and absence of seed crystals. With commercial lime neutralization the addition of seed material following neutralization appeared more effective than comparable additions prior to neutralization. Increased dosage of crystal seeding was found to compensate for the difference in effectiveness. High dosages (30,000 to 60,000 ppm or higher) are required to effect rapid stabilization. The use of a high concentration of return sludge solids will provide simultaneous control of

Three P.F.T. Heater and Heat Exchanger units serve modern plant at York, Pa.



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POSITIVE SAFETY FROM CONTAMINATION

In these P.F.T. Exchangers, 6" interior tubes carry sludge, while 8" outer tubes carry heating water in the opposite direction (counterflow). Exclusive P.F.T. multiple-gasket joint design makes any leakage of sludge quickly detectable on the outside of the unit. This positively prevents contamination of water circulating in the 8" tubes, and safeguards the cooling system against costly clogging.

P.F.T. is the only manufacturer of both *shell and tube* type and *concentric tube* heat exchangers for sewage treatment. York thus could be sure of getting the best suited equipment for their sludge heating operation.

After careful analysis, three P.F.T. #605 Heat Exchangers of the concentric tube type were specified. Rated output is 1,000,000 B.t.u. per hour each. All parts are readily accessible. Return bends are easily removed for inspection and cleaning of both sludge and water tubes.

Digesters are economically heated by transferring waste heat from two 150 hp. gas engines to sludge recirculating through the #605 exchangers. P.F.T. Gas Safety Equipment protects the digesters and sludge gas system from flash-backs at the engines and boilers.

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supersaturation of calcium sulfate and production of rapid settling sludges.

"Control of Calcium Sulfate Supersaturation During Lime Neutralization." By W. A. Parsons and H. E. Orford, Rutgers University. *Sewage and Industrial Wastes*, November.

Removing Dust from Flue Gas

Flue dust and sludge resulting from operation of a typical blast furnace at the plant of the American Steel and Wire Division of the U. S. Steel Corporation near Cleve-

land amounts to 180 tons per day. In addition 6,000 tons of gas are produced per day. Flue gas discharged from the furnace is passed through a dustcatcher where 140 tons per day of dust are removed. The exit gas from the dustcatcher travels to a gas washer where counter current flow against water sprays extracts additional solids. The gas effluent from the washer contains 0.15 grains per cu. ft. of dust and is subjected to further treatment in a battery of three electrostatic precipitators. The final effluent contains less than 0.01 grain of dust per cu. ft. Waste water

from the gas washer and precipitators is processed in thickeners and a disc continuous vacuum type filter.

"Blast Furnace Flue Dust Treatment Facilities." By William H. Weise, American Steel and Wire Division, U. S. Steel Corp., Cleveland. *Sewage and Industrial Wastes*, November.

Trailers Used for Waste Control

Charlotte, N. C., has equipped two house trailers with instruments for checking industrial waste characteristics on a 24-hour basis, thus helping to enforce the City's ordinance on waste discharges to the sewer system. Measurements possible include pH monitoring and recording and flow rate and volume indicating and recording. Automatic samplers made by the Chicago Pump Co., a Leeds and Northrup pH recorder, and two Hagan flow meters comprise the equipment. More than 60 industries are checked periodically to determine if regulations are complied with.

"Trailer-Borne Instruments Enforce Sewage Ordinances." By W. M. Franklin, Supt. Water Dept., Charlotte, N. C. *The American City*, December.

Sewage Plant Treats Packinghouse Wastes

Following an agreement between Union City, Tennessee and the Reelfoot Packing Co. whereby the latter would pretreat its wastes to a BOD of 500 ppm, a plant was constructed by the city for handling the wastes which contributed 25 percent of the total flow and 50 percent of the total BOD. The principal plant units are a grit chamber, cutting screen, primary settling tanks, roughing filter, aeration tanks for activated sludge treatment, final sedimentation tanks, and a coil spring sludge filter. The plant was designed on a basis of 1.23 mgd average flow and a BOD loading of 2,665 lbs. per day. The roughing filter design loading was 200 lbs. BOD per 1000 cu. ft. The retention time in the aeration tanks is 5 hours. A 100-sq. ft. coil-spring sludge filter is used to process an estimated 2,700 lbs. of dry sludge at 6 lbs. per sq. ft. per hour after conditioning the raw sludge with ferric chloride and lime. There has been a continual demand for the use of the filtered sludge as a fertilizer on farms adjacent to the city.

"Joint City—Packinghouse Plant Provides Economy and Efficiency."



Tapping into a water main under pressure is a comparatively easy and simple operation with the use of an M & H Mechanical Joint Tapping Sleeve and Tapping Valve.

The sleeve has split-end gaskets and split glands, and may be used with Classes AB or CD pit cast pipe or Classes 100, 150, 200 or 250 centrifugally cast iron pipe. The glands have cup point set screws for centering them around the pipe. The sleeve has side and end gaskets of compound rubber which fit against each other to make a watertight seal.

The tapping valve is standard M & H design, double disc, parallel seat, NRS, and has a flange on one end for bolting to the tapping sleeve. The outlet end fits any standard tapping machine and may be ordered for either hub or mechanical joint pipe connection. Write or wire

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Surgeability is defined as stability of performance under rapidly changing and unpredictable conditions including flow. This characteristic is vitally important in clarification and cold process softening installations. Surgeability is designed and built into the Graver Reactivator®

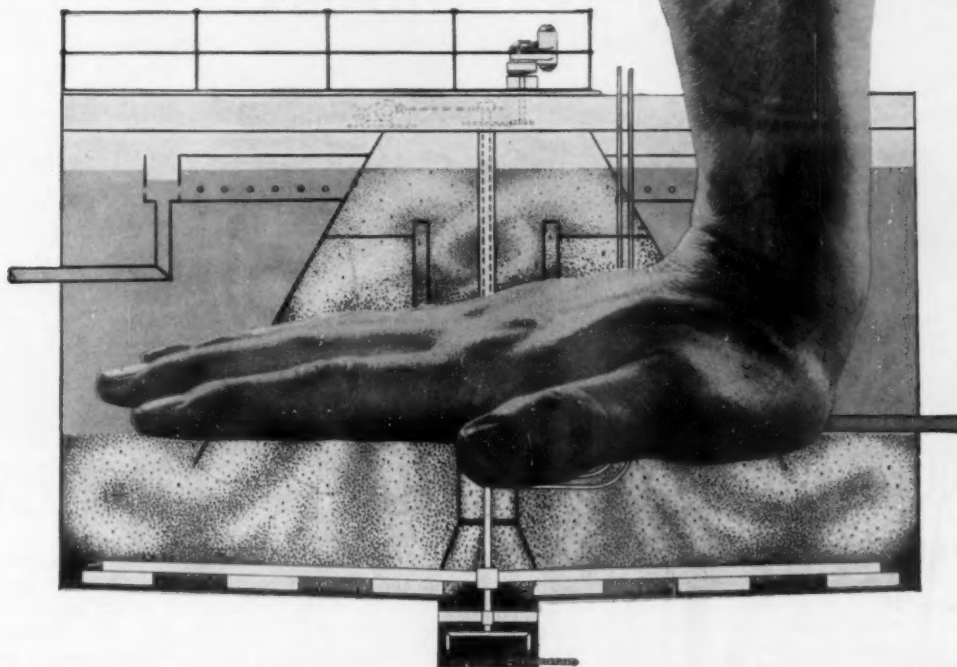
Once optimum chemical conditions are established, there are two important features that give the Graver Reactivator a high surgeability factor:

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Low Sludge Level . . . providing maximum depth of clarified water between sludge-clear water separation zone and the effluent collector.

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Rugged construction
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By Russell and Axon, Consulting
Engineers. *Wastes Engineering*,
November.

Tolerance of Biological Treatment to Plating Wastes

Laboratory studies on the effect of simultaneous feeding of plating solutions containing chromium, copper, nickel, zinc and cyanide to activated sludge and sewage showed that after a 3 to 5 day period the ability of the activated sludge to oxidize sewage had been adversely affected. Observations were also made on the effect of plating wastes on a trickling filter plant at Marion, Ohio, and an activated sludge plant at Shelby, Ohio. At Marion, where the waste flow amounted to nearly 20 percent of the total flow, part of the copper, chromium, and cyanide was removed by primary sedimen-

tation units and part by the filters. Tolerance by the plant units without material reduction in efficiency was observed. At Shelby, similar effects were noted with a part of the metals and cyanide removed in primary treatment units, and considerable overall reduction without a decrease in sewage treatment efficiency was observed. Sludge analyses at the two plants indicated no definite interference with digestion processes. Some accumulation of metals in the trickling filter slime at Marion and St. Mary's, Ohio, occurred and it is suspected that this affected the operation of both plants to some extent.

"Metal Plating Wastes and Sewage Treatment." By Donald Tarvin, Floyd G. Browne and Associates, Consulting Engineers, Marion, Ohio. *Sewage and Industrial Wastes*, November.

A Plan to Finance and Construct Sewage and Waste Treatment Facilities

THROUGH A NEW financing concept, sewage treatment plants for municipalities and waste treatment facilities for industries can be designed and constructed without any capital investment or increase in bonded indebtedness on the part of the user. The cost of the plant is liquidated by equal annual payments over a period of years, after which the plant becomes the property of the community or the industry. The annual payments are covered by sewer service charge, in the case of a municipality.

The procedure is as follows: A corporation is formed to act as owner and builder of the proposed facilities. In effect, this corporation will then act as a utility. It will enter into an agreement of intent with the municipality and, following joint approval of the preliminary engineering report, it will effect lease arrangements with the municipality. The design of the plant is subject to joint approval, after which construction is undertaken under the supervision of the consulting engineers. The corporation finances the entire project. Payment by the city is from sewer service charges which, of course, must be adequate to carry the rental charges. The basis of the leasing cost is the cost of the plant.

Design can be by the municipality's consulting engineers; the

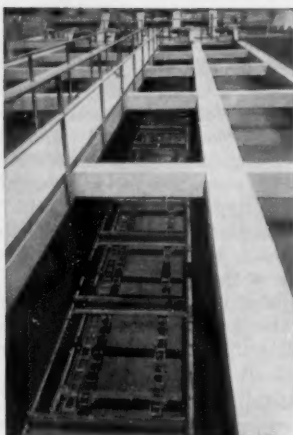
state sanitary engineer must approve the design. After the plant is built, it can be operated by the municipality or by the corporation, in which case a fee for this is charged. Income from the sewer rentals (or from water sales in the case of a water utility) is designed to pay for the plant within its depreciation period; or the city can purchase it whenever it desires to do so.

This plan is new to the sewerage field and, in part, to the water works field, but it has been widely used in other utility areas. It is of much advantage for city conditions when bond limits have been reached; and it is especially advantageous for industry. There is no capital cost to depreciate over the years. Instead, under the lease arrangement, all costs, both rental and operation, are deductible operating expenses.

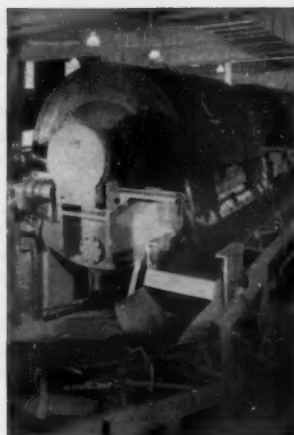
The annual payments under this plan are said to be essentially the same as would be required for interest and amortization of a bond issue. Its use permits available remaining bonding capacity to be utilized for other needed improvements. The plan as outlined here has been developed by the Municipal Service Co., 4625 Roanoke Parkway, Kansas City, Missouri. Material is available from that company which describes the plan and its advantages fully.



PRE-AERATION increases efficiency of 20 tanks equipped with sludge collectors. Air floats grease, flocculates solids and adds dissolved oxygen to the effluent.



FOUR LINK-BELT grit collectors slow sewage velocity to 1.25 fps . . . and remove grit from lighter solids that remain in suspension.



SLUDGE CAKE is conveyed from vacuum filters by Link-Belt belt conveyors. It is used as "Soil Conditioner" by the City Park, nurseries and home gardeners.

How Sacramento effectively controls ODOR - - POLLUTION - - DISPOSAL

LINK-BELT pre-aeration and sludge removal equipment satisfies rigid water purity standards

SINCE 1949, Sacramento's population and industry have increased 50%. To stop odors and water pollution in the Sacramento River, the city recently installed a new sewage treatment plant equipped with Link-Belt grit collecting and washing equipment, sludge collectors and skimming equipment, and belt conveyors for handling the dewatered sludge. The equipment was included in specifications drawn up by the engineering office of Clyde C. Kennedy, Consulting Engineers.

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The Status of Membrane Filter Use

IT HAS BEEN only since World War II that cellulose derivative filters, popularly known as membrane filters have become prominent in water bacteriology. Goetz, in 1947, made known the newer methods of using cellulose ester as a filter material which he observed in Germany. This information was not generally available until 1951 when Clark et al., and Goetz and Tsuneishi published the results of their preliminary work on the application of the technique to the enumeration of coliform bacteria. In the following years, numerous

other papers have described experiences with the membrane filter technique.

The new tenth edition of *Standard Methods for the Examination of Water, Sewage, and Industrial Wastes* includes as a tentative procedure a method for the enumeration of coliform bacteria with the membrane filter technique. This, it is hoped, will stimulate even more work with the filters.

One of the most important papers on the subject published recently dealt with a comparison of results obtained from the simultaneous ex-

amination of water samples by the membrane filter and most probable number (MPN) procedures. Working in conjunction with the Public Health Service, a number of State and city health department laboratories, analyzed a total of 1706 water samples by each method. The results were compared on the basis of the 95 percent confidence limits of the confirmed MPN, and it was found that 73.8 percent of the results were in agreement. There was no correlation, however, between recorded chemical or physical properties of the water and agreement or disagreement of results. Furthermore, it was concluded that the "test procedures do not measure precisely the same group of organisms and that the sanitary significance of the differences in the results of the procedures is yet to be determined."

This conclusion implies that caution should be observed in using the membrane filter technique in the routine assessment of water quality in lieu of the standard MPN method because of the difficulty in interpreting results. Until such time as a sufficiently large body of information becomes available, the routine use of the membrane filter appears undesirable. This is not to say that there are no conditions under which the membrane filter can be of value other than for research. The membrane filter can be used to advantage when time or materials are limited. Whereas a confirmed MPN test requires 48 to 96 hours, results can be obtained by means of the membrane filter within 24 hours or an even shorter time. Thus, it is possible to make emergency administrative decisions on water quality, based on laboratory results, within one day. And, if conventional laboratory facilities are not available, field kits for using the membrane filters can be prepared: Ointment tins or plastic petri dishes can be used in place of glass petri dishes and an incubator vest employed.

To simplify the procedures still further, a unit is commercially available which contains all the equipment necessary for using the membrane filter. It is claimed that this unit can be used independently of a standard laboratory, does not require any utilities, and is ideally suited for field work. Included in this unit, and also separately available, are presterilized filters and prepared nutrient pads which require only the addition of sterile water before use. These "nutrient schedules," described by Goetz, et

Progress in Air Transportation

THE Port of New York Authority's West 30th Street Heliport represents a new era in the field of heliport development and helicopter transportation in New York City. Commercial flights started in late September when twin S-55 helicopters of New York Airways took off on the first flights for La Guardia and Newark Airports, carrying cargoes of mail including several thousand "first flight" covers bearing special cachets.

It is predicted that by 1970 helicopters will carry five million passengers a year between Manhattan and nearby communities and airports.

Construction of the \$320,000 heliport began in July, 1956. The area

leased from the City includes a strip of land 70 by 400 feet along the bulkhead as well as the water area between the existing bulkhead and the United States Pierhead Line, which is about 500 feet off-shore at that point. The heliport comprises two touchdown pads, each 80 by 80 feet, projecting 40 feet out from the bulkhead. These landing pads are constructed of reinforced concrete, with the portions beyond the bulkhead supported on steel H-piles.

A helicopter parking area 50 by 50 feet is provided between the two touchdown pads and there is a 20 by 40-foot terminal building at the northern end. The heliport is surrounded by a 10-foot-high protective fence.



● ARTIST depicts the New York Port Authority's West 30th Street Heliport.

al., eliminate all need for preparing media or sterilizing filters, pads, or media and, as such, decrease the time involved in making laboratory tests. However, the value of these nutrient schedules has not yet been determined independently. It would appear that these packs may be well suited to the small laboratory making infrequent use of the membrane filter. For laboratories doing more membrane filter work, the relatively high cost of such packs, as compared with the cost of the individual components which in themselves are still quite expensive, might preclude the use of prepared packs.

It should be noted that none of the above applications of the membrane filter are recommended for ordinary situations. In the ordinary base-laboratory use of the membrane filter, certain aspects of procedure have appeared to be unnecessarily involved. Slanetz and Bartley have very recently published the results of their attempts to simplify procedure. They recommended that the preliminary incubation on an enrichment medium is not only unnecessary, but that it may even be undesirable. Hajna and Damon also recommended a one-step incubation using a medium of their own development.

After comparing a variety of selective media for coliforms, such as the commercially available dehydrated M-Endo broth, EHC modified Endo broth, and others, Slanetz and Bartley concluded that the commercial dehydrated material is most satisfactory from the point of view of coliform yields. Another simplification which they proposed would eliminate the need for an atmosphere saturated with water. They found that normal hot air incubation did not decrease coliform counts.

With certain waters, particularly those with relatively high turbidities and low coliform counts, difficulty is encountered in making a quantitative estimation of the coliform bacteria. The deposition of large quantities of suspended material frequently causes confluent bacterial growth on the filter and may make it impossible to do a colony count. Using the standard size membrane filters which are about 50 mm. in diameter, the volume of water which can be filtered is small. It is possible, however, to use larger filters, thereby spreading the solid material over a larger area and reducing the interference. Goetz, et al., described a unit adapted for use with filters that are 9 cm. in diameter.

The membrane filter technique is not limited to use in the recovery of coliform organisms. It may be used to make total bacteria counts and counts of specific organisms, such as *Salmonella typhosa* and fecal streptococci, or to aid in the differentiation of members of the coliform group. It probably could be adapted for study of any organism or group of organisms occurring in water. These procedures for non-coliform organisms may be extremely valuable because of the low density of such bacteria in water and the fact that large water samples may be used when the membrane filter is used.

In emergency situations when it is impossible to use the MPN method, the membrane filter procedure may be used to give approximate results. Because of the special uses to which the membrane filter can be put, laboratory personnel are encouraged to become familiar with the procedure.

The data in this article are abstracted from "The Present State of Knowledge Concerning the Membrane Filter in Water Bacteriology," by A. E. Greenberg, L. Yee, and F. W. Hartmann, *The Public Health Laboratory*, May 1956. Similar data appeared in the U.S. Navy *Medical News Letter*, Vol. 28, No. 9.

City Tunnels Under Railroad for Interceptor Sewer

A CITY has many problems when it grows or expands in population and area. Among these are building and expanding its storm and sanitary sewers. Frequently these sewers have to pass under railroad tracks.

When the city of Topeka, Kansas, built its Shunganunga interceptor sewer, it was necessary to cross the main line of the Atchison, Topeka and Santa Fe Railroad yards at a point where the sewer is 48 inches in diameter. To avoid disturbing the regular flow of railroad traffic, it was decided to tunnel under the tracks. The bid price for this portion of the job included excavation and shoring of the pits, installing the tunnel and grouting outside the liner plate. The tunnel itself is 5-gauge black steel, 373.5 feet long

and 84 inches in diameter. Flow line of the tunnel is 27 feet below the base of the track line.

Pits were shored with 12-gauge black steel Armco flange type sheeting. Use of this sheeting to construct a sloping ramp speeded dirt removal by allowing a motorized wagon to operate in the tunnel.

General contractor for the job was Douglas Brothers of Topeka. The Construction Department of Armco Drainage & Metal Products, Inc., Midwestern Division, subcontracted the tunneling under the tracks. Tunneling was started on March 13, 1956, and finished on May 2, 1956. Three shifts were used, each shift having three men and a foreman. Engineers for the entire sewer project were Servis, Van Doren and Hazard of Topeka, Kans.



● EXCAVATING tunnel beneath a railroad for interceptor sewer in Topeka, Kans.

Thruway Sewage Plants

(Continued from page 102)

has been made for the drying of the sludge at the plant site. The sludge is to be pumped into Scavenger trucks which will dispose of it at sites approved by the Authority and acceptable to the State or County Department of Health in which the plant is located. The sludge piping arrangements within the pump house allow complete flexibility, that is, either the primary or secondary pump may be used to pump sludge from either the primary or secondary clarifier. Either of these pumps may also be used to pump sludge from the digester to the ultimate tank disposal.

The sludge is collected mechanically in the primary and secondary clarifier and is pumped to the digester by either of the two sludge pumps. These two sludge pumps are on automatic operation, that is, a time clock starts either sludge pump in operation. The setting of the time clock varies with the different plants depending on the amount of sludge that is collected. Supernatant liquor is returned directly to the primary clarifier. At the effluent of the chlorine contact tank, a 90° "V" notch weir has been placed directly before the plant outfall. With the aid of a stage recorder and the use of this "V" notch weir, an accurate flow pattern can

be established. The flow data obtained at this point can be checked against the total daily water flow at the service area since there are water meters at all softeners as well as a master water meter which indicates the total usage of water at the service area.

The major problem in the operation of these plants to date has been the fact that the plants were over-designed for the flow that is now being treated. As traffic increases on the road, however, it is expected that the flow will approach the design capacity of the plant. At some locations, during the winter months, recirculation ratios as high as 30 to 1 are being used and it is hoped that some data may be collected indicating the effects of high recirculation ratios on treatment.

Because competition in the bidding for equipment was desired, the sewage treatment plants have the equipment of many manufacturers installed in similar operations. Manufacturers that have supplied equipment for the sewage treatment plants include Infilco Inc., Chicago Pump Co., Jeffrey, Yeomans, Chain Belt, Pacific Flush Tank and Process Engineers. The gas chlorine machines are Fischer and Porter or Wallace and Tiernan, while the hypochlorinators are Wallace and Tiernan or Proportioners.

densities and the establishment of the triangulation datum. The value of accurate vertical and horizontal control has been recognized in the long range planning of the Water Resources Development Program.

Needs for geodetic measurements arise also from the sinking of the land surface over extensive areas where water or oil has been extracted, as in certain parts of Texas and California; or where parts of the earth's crust have been heavily loaded by the works of man, as with the Hoover Dam and Reservoir. There is an increasing recognition of the value of geodetic methods in such projects as the design and construction of long bridges, tunnels, hydro-electric and multiple purpose dams and reservoirs, pipelines, transmission lines, and cadastral surveys generally. The bridges across San Francisco Bay, Mackinac Straits and Lake Pontchartrain are cited as examples where because of the length of structure geodetic measurements were found necessary.

The States are recognizing basic geodetic data as a prerequisite for the planning and construction of our national highway systems. In fact surveys and maps are required in the planning, location, design, and construction phases of practically every conceivable mode of transportation with the possible exception of the elevator. Experience indicates the desirability of placing these surveys on one system so that all coordinates for mapping, traversing, engineering and property surveying will be expressed in common terms of a coordinate system. Assurance is provided that all the sections will ultimately fit, both statewide and nationwide, by use of state plane coordinate systems, based on high-order geodetic control. Several state highway departments are already using geodetic control as a basis for their highway surveys. Massachusetts and Connecticut use this control exclusively, whereas other states, such as Nevada, California, Virginia, Florida and others, use the control frequently.

The Coast and Geodetic Survey has recently completed surveys establishing control points at intervals of 3 to 4 miles along the proposed Tacoma-Everett toll road in the State of Washington. Similar spacing is provided along sections of U. S. 40 in Maryland which have been proposed for realignment. All of the photogrammetric field control for the recent extensions of

150 Years of Accuracy: Story of the U. S. Coast & Geodetic Survey

(Continued from page 116)

undergoing field tests. This rod mark, driven into the ground to a depth of 50 feet or refusal is being placed along the leveling lines replacing every fifth monument. A white wooden 4 by 4 witness post is set at each bench mark when practicable.

Geodetic Control Applications

These precise determinations of points of known latitude and longitude, direction and distance, and of known elevation are becoming more and more in demand. Horizontal control, either in terms of latitude and longitude or of State plane rectangular coordinates, and the vertical control are requested by various Federal organizations such as the Geological Survey, Soil Conservation Service, Bureau of Reclamation, Forest Service, Atomic Energy Commission, Corps of Engineers, other Defense Department agencies and the Territorial governments. Further demand is made by

city, county and state engineers and surveyors, and by private organizations such as public utilities, irrigation districts and others.

Geodetic control is used as control in the orientation, location of features, grid connection and contouring for nautical and aeronautical charting and for topographic, military, and special mapping. It is used in earthquake investigation of horizontal and vertical crustal movement. Demand is made for both precise horizontal and vertical control in scientific studies and special engineering projects which have included speed of light experiments, synchrotron locations and elevations, the Taylor Model Boat Basin surveys and others. Scientific studies involving C&GS geodetic astronomy and gravity provide information necessary for the determination of the size and shape of the earth, the investigations of the effects of the earth's gravity field on the flight of guided missiles, the interpretation of the earth's crustal

the Pennsylvania Turnpike was tied into monuments established by the Coast and Geodetic Survey for both horizontal and vertical positions. Similar use of C&GS monuments was made along the Ohio and Indiana Turnpikes.

Geodetic Control For Aerial Surveys

Horizontal and vertical geodetic control surveys provide the framework for photogrammetric mapping. Geodetic control is bridged by aerotriangulation and additional geodetic positions and elevations are obtained where necessary to map a specified area.

The principal use in the Coast and Geodetic Survey for aerial surveys is to provide basic information for nautical and aeronautical charts, prepare airport obstruction plans and to locate supplementary control for hydrographic surveys. A recent new application, now in the experimental stage, is to prepare hurricane warning maps of developed coastal areas at large scale with a one-foot contour interval. These maps indicate areas that would be affected by storm tides and will be used for evacuation and damage assessment studies.

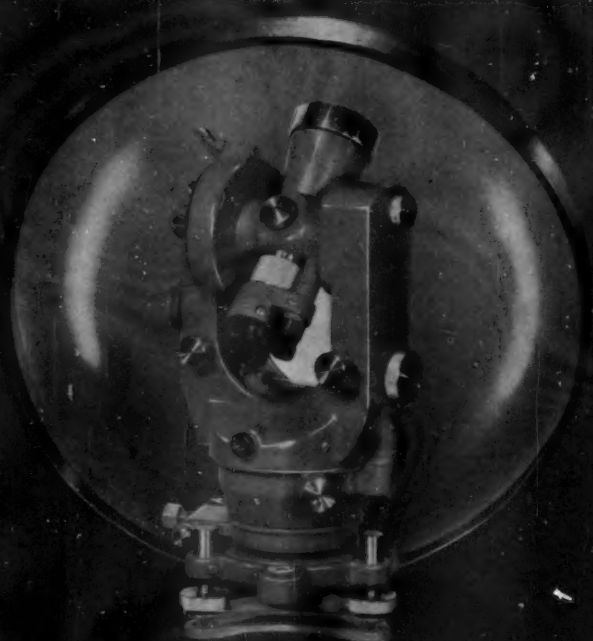
The amount and placement of geodetic control necessary for a photogrammetric survey is determined by the requirement that all well defined points on the completed map are within 0.5 mm. and all photogrammetrically located control points for future surveys are within 0.3 mm. of their true geographic positions. Ninety percent of all tested elevations on the map are required to be within one-half the contour interval of their true elevation.

One of the principal considerations in planning flight lines for aerial photography is to take advantage of the placement of existing geodetic control to minimize the necessity for establishing new control in the field. At least three horizontal and four vertical control stations are theoretically necessary to adjust a single bridged flight, and more points than this are required for practical reasons.

Geodetic control is identified on the photographs in the field by indicating the stations that are visible on the photographs, such as, elevated tanks, stacks or church steeples. Stations that are monumented are usually marked on the photographs by selecting a photographic image that can be identified within 0.15 mm. A geodetic azimuth and distance from the control station

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enable the compiler to compute a position for the substitute station.

Precise stereoscopic instruments, such as the Zeiss stereoplanigraph, are used to obtain coordinate positions based upon a rectangular grid system in the instrument for any specified number of points along a flight line. Diapositive prints are made on glass from the film exposed in the aerial camera. As there is a 60 percent overlap between adjacent prints along a flight line, a stereoscopic view of the common area on two prints is obtained when the glass plates are placed in the instrument and relatively oriented. Each succeeding plate can be mechanically connected to the first two so that all points selected along the strip are in the same relative orientation without regard to scale, azimuth or elevation.

The instrument coordinate positions of all points may then be converted mathematically to a ground coordinate system based on the horizontal control that was identified at each end of the strip. The necessary calculations are completed in two or three hours for several hundred points using electronic computers. Residual systematic errors at all stations along the strip are then removed graphically. Instrument departure from true azimuth and scale results in a smooth curve. The magnitude of discrepancies at the centrally located control points enable the adjuster to apply by graphic methods a systematic correction for all points along the strip. Vertical bridging may be accomplished in a similar manner if necessary.

Positions are so determined for points at close intervals along intricate coastlines where signals can be erected at recognizable points on the photographs to control offshore soundings and the accurate location of the mean high and low water lines. The positions and elevations of four selected points in a stereoscopic model enable the map compiler to locate accurately alongshore planimetric features, contours, offshore rocks and dangers to navigation required by nautical and aeronautical charts. The model is reset in a compiling instrument, such as the Kelsh plotter, scaled and leveled on the plotted positions and elevations and intricate detail can be traced in its true geographic location. On airport obstruction plans, azimuths and lengths of runways, positions of obstructions and aids to navigation, as well as the geographic position of the airport, can be determined with little field work.

All positions and elevations so obtained can be expressed in terms of state plane coordinates based upon the North American 1927 Datum and the Mean Sea Level Datum of 1929. Positions of more or less permanent features, such as road or sidewalk intersections, fence corners, etc., can be used as control to locate new installations, obstructions, or shoreline changes from new photography without additional field work.

The State Coordinate Systems

The importance of the state plane rectangular coordinate systems to private, industrial, city, county and state surveying and engineering is well known. The first state system was devised by the Coast and Geodetic Survey following a request by the North Carolina Highway Department, the first to foresee the advantages of coordinating state highway surveys on a state-wide datum using the national horizontal net, but involving only the formulas of plane surveying.

The idea of coordinates in surveys is not new. A form of coordinates was probably used in ancient Egypt in connecting the rich Nile valley land corners to points on higher ground safe from devastating floods. The land surveyor of today uses plane rectangular coordinates when he traverses the boundary of a farm and computes the latitudes and departures of its corners, referred to an arbitrarily selected origin and meridian of reference.

The North Carolina Coordinate System was established in 1933. By means of this system all geodetic positions of triangulation stations within the State could be transformed into x and y coordinates on a single grid. During the following year or so similar systems were devised for each of the 48 states. In developing the state systems, projection from the spheroidal surface to a plane surface was not only necessary but had to be accomplished with a minimum of distortion over the largest allowable area. This was essential in insuring the practical value of precise geodetic control to practicing surveyors.

Experience indicated that strips of the spheroidal surface not exceeding 158 miles in width could be projected upon the plane without exceeding a distortion in scale of 1 part in 10,000. This width was adopted thereby eliminating the need for distortion correction in the use of the control for surveys of

lesser precision. Relatively simple computations can be made for those surveys requiring more precise control.

All state areas were divided in a manner to provide the least number of zones, which would be of indefinite length but would have a maximum width of 158 miles. Two types of zones using two different methods of projection were used. When the greatest extent of a state is in an east-west direction with comparatively narrow width in a north-south direction the strips or zones lie in the east-west direction on a Lambert conformal conic projection with two parallels held true to scale. Along these two standard parallels the scale is exact; between them the scale decreases and increases outside of them. Along a given parallel the scale is constant, but it varies from parallel to parallel. A table is available giving the scale variation for every minute of latitude so that full allowance may be given these variations in any computation.

When the greatest extent of a state lies in a north-south direction with limited width in the east-west direction, the zones lie in the north-south direction on a transverse Mercator projection. This projection is related to the meridian in the same way that the familiar Mercator projection is related to the Equator. In order to bring about a balance of scale in this case, the scale is reduced a certain amount in the center of the projection, thus providing for holding the scale along two small circles of the earth parallel to the meridian. The scale is then constant along any small circle parallel to the central meridian, but varies with the distance from this meridian. A scale factor for every 5000 feet from the central meridian may be obtained from tables especially prepared for each State using this system.

All Coast and Geodetic Survey geodetic triangulation positions are converted to State plane-coordinates immediately after adjustment. Tables have been prepared for all of the 48 States on either the Lambert or Transverse Mercator Systems and laid off in zones ranging from one zone to seven zones depending upon the size and shape of the respective states.

Some twenty-five states have officially approved the use of state plane coordinates in recording land surveys. The State of New Jersey was the first to initiate this action. The twenty-five states which now

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have such laws have all patterned their respective laws after a model drawn up by the Coast and Geodetic Survey. A copy of this model legislation may be obtained upon request to the Director, C. & G. S.

State and Local Uses

In addition to the many functions served generally by both horizontal and vertical control, these data are of particular value to the state and local engineer and surveyor. The usefulness of State Survey and Map Offices is now recognized where data and information related to control surveys are filed, and made available to surveyors and others. A state office of this kind is of immeasurable worth in time and money. Through this office may be obtained the descriptions and coordinates of all geodetic stations of the respective states including both those of the national net and the local nets. When such an office is not available the necessary data for the national control must come directly from the Federal Government through the United States Coast and Geodetic Survey.

One of the most important assets in surveying is having a good solid point and direction at the origin and the terminus of a project. Per-

manence is a prime factor, and recovery becomes an indispensable factor. The controlled survey is not dependent upon material monuments for permanence. If a triangulation station is completely lost, the point on the ground is defined by the station's coordinates. The lost station may be re-established by surveys originating at other stations of the basic net. The recovery of a lost boundary marker or land corner—city, county or private—could be effected in the same simple manner, should such marker be tied to the geodetic net through the state grid.

In connecting a local survey to more than one point in the State Coordinate System, the surveyor has automatically introduced a tremendous potential for increased accuracy. If a connection can be made so that the computations may be carried through the local survey starting at one control station and closing on another, then traverse closure adjustments may be made which will largely eliminate systematic errors and greatly diminish the effects of accidental errors.

In 1935 the Tennessee Valley Authority adopted the State Plane Coordinate Systems citing several reasons. This decision was based on

the fact that TVA surveys would attain an official status within the states more quickly; that sufficient accuracy over a large area for all-purpose surveys would be obtained; that more over-all agreement and more efficient conversion between surveys of all federal, state and local organizations could be obtained; and that the highly desirable objective would be achieved of getting all local property upon a permanent and recoverable basis with the official status provided by the State Coordinate System.

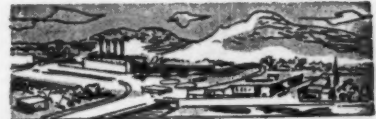
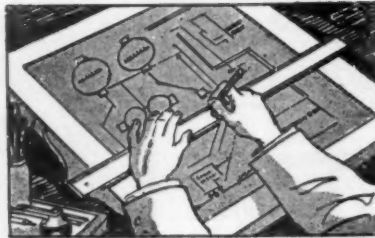
Although coordinates cannot be expected to outweigh the physical evidence of the corner monument as the point which firmly establishes the corner regardless of position on the grid, still the plane coordinates of that corner, should the monument be lost, are the best available evidence of position and the best means toward restoration. The Bureau of Land Management of the Department of the Interior has recognized the advisability of tying Federal land surveys into the triangulation system of the country. That agency has cooperated in the work necessary to connect new triangulation with the section corner monuments already established.

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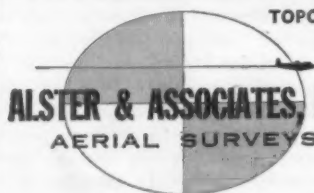
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realize that the early method of tying each parcel of land to one or more separate points of reference, has been unsatisfactory. Frequently the reference points are known only to the original surveyor, and are not available to the general public. But if the city lots are referred to a single coordinate system, such as is furnished by high-order triangulation and traverse, then the lot corners may be located by reference to any one of a number of control stations of the city survey.

The land surveyor of today must attack his jobs with a definite regard for time and money saved. He realizes the importance of having several units in the field working at once and the satisfaction of having the total work over the area consistent with the coordinate grid and thus consistent within itself. He sees the savings in accurate reference to the control system in that the necessity is greatly lessened of maintaining many monuments, posts, pipes and other markers over long periods.

The need for adhering to the outline of a tract or to the boundary through difficult terrain is largely supplemented by random traverses from the coordinate control points which may be selected for convenience and with a great saving in time. Checking out old magnetic bearings has been a most exasperating chore for the land surveyor throughout the centuries. Whenever possible many accept with relief the unchanging and accurate azimuths of the State Plane Coordinate Systems.

The advantages in the use of the coordinate system have been recognized by many cities and counties. Municipal engineering departments are required by law to provide information relative to boundaries of public and private property, the location and establishment of grades for streets, sewers, sidewalks and curbs, and the elevation above a common datum of any point within a reasonable distance of an intended project. The city of Bridgeport, Conn., has a "City Geodetic Control Survey" to conduct this work, basing its specifications upon those of the Coast and Geodetic Survey and referring the local surveys to the Connecticut Coordinate System. All final elevations in Bridgeport are adjusted and referred to the Federal datum. The city of Alameda, Calif., has established a policy to base property descriptions written by the city upon the California Coordinate System.

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Through cooperation with, and at the request of, the local govern-
ments, the Coast and Geodetic Sur-
vey has recently completed hori-
zontal control surveys for the East
San Francisco Bay area, for the
municipalities of San Antonio, Tex.,
Cincinnati, O., and Jackson, Tenn.,
and for Mahoning County, Ohio.

Large industrial and construction
projects are rapidly appreciating
the advantages to be derived from
the national vertical and horizontal
control networks. The Pennsylvania
Water and Power Company, the
American Telephone and Telegraph
Company, the Houston Lighting and
Power Company, and the Texas
Division of the Dow Chemical Com-
pany are among some of the indus-
trial concerns that have coordi-
nated their engineering surveys
through the geodetic system.

Geodetic Vertical Control

Many of the requests and uses
for horizontal and vertical survey-
ing control stem from the same
sources. Both are needed in topo-
graphic mapping, in earthquake
and subsidence studies, in city plan-
ning and in military mapping.

The vertical control network
provides for the local surveyor a
framework based on one datum ad-
justed to mean sea level as deter-
mined at 26 selected tide stations
established along the Atlantic, Gulf
and Pacific coasts of the United
States and Canada prior to 1929,
the year the last nationwide adjust-
ment was completed. Since that
time there have been some addition-
al area adjustments made where the
level net has been connected to basic
tide stations at other than the origi-
nal 26 points used in the 1929 ad-
justment.

Increasing demand is being made
for accurate and consistent eleva-
tions in the construction of our
modern highways. Vertical aline-
ment, as well as horizontal, is much
more of a problem in this present
age of high speed. Grade and curves
present requirements for accuracies
far above those needed twenty years
ago. Topographic route mapping
necessitates control over long cross-
state stretches. Accurate basic con-
trol is highly desirable in connection
with highway engineering involving
grade separations, access clover-
leaves, and tunnels.

The Mackinac Straits Bridge, the
many single and multiple purpose
water resources developments
throughout our West, and even the
renovation of the White House in
our Nation's Capital serve as exam-
ples of special requirements.

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This precise yardstick of elevation is sought by many cities, counties, and states for street, sewer utility, highway and other planning. Leveling surveys have been made by the Coast and Geodetic Survey in the cities of Fort Worth and Dallas, Texas; in Cincinnati, Ohio; and in Cook County, Illinois, and Mahoning County, Ohio, for the purposes of city and county planning. Similar geodetic leveling surveys were undertaken in San Antonio and Houston, Texas, in New Orleans and in the Terminal Island and the Los Angeles-Long Beach, California areas to provide data for the study of the serious and costly problem of subsidence.

Vertical movements in the subsidence areas must be interpreted from repeated leveling every two to five years. For many years the subsidence of the earth's crust has been realized at several different points in California and in other parts of the United States. The subsidence at Long Beach has exceeded 20 feet. Publicly-owned utilities that are being damaged or are subject to possible damage as a result of subsidence include water-supply and distribution systems, domestic water and sewerage systems; dams; roads; bridges; levees; other flood-control structures; and power installations. Private utilities include most of the above and railroads, pipelines and wells in addition.

The purposes of maintaining a vertical control program in the subsidence areas are to establish over-all datum and reference ties to ocean tide gages and mountain bedrock for comparative purposes; to provide periodic leveling to define rates and changes in the problem areas; and to provide for the extension of the regular net which will form a base for general topographic and special surveys.

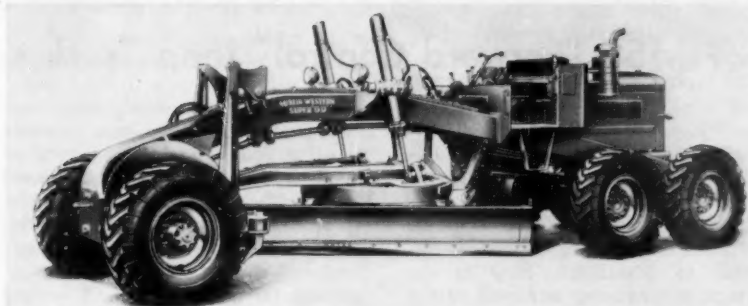
Over a period of 150 years the Coast and Geodetic Survey has contributed immeasurably to the national welfare by meeting the ever-increasing demands for horizontal and vertical control for mapping, land surveys, engineering and scientific pursuits. These vital services in the field of geodesy place in the hands of the surveyor and engineer a valuable tool which adds greatly to the scope and accuracy of land surveying and engineering enterprises. Geodetic survey data in the form of elevations, plane coordinates, geographic positions, and descriptions are available on request to the Director, U. S. Coast and Geodetic Survey, Washington 25, D. C.

PUBLIC WORKS EQUIPMENT NEWS

Published Monthly

January, 1957

Graders For Highway Construction and Maintenance



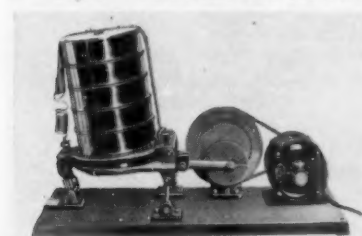
A completely new grader, the Austin-Western super 99 power grader, is the largest of the firm's four graders and has both six-wheel drive and six-wheel steer

A power grader with the exclusive six-wheel drive and six-wheel steer and optional torque converter has been announced by Austin-Western. It is the largest and most powerful of the firm's four models and incorporates such features as precision sideshift, high-lift blade, extreme blade reach, completely reversible blade and hydraulic controls. However, from a job-performance standpoint, the Super 99 focuses greatest attention on "the ultimate in controlled traction."

This is attained when the dual function of directional control (through the all-wheel steer) and the "push-pull-power" of all-wheel drive are fully utilized. The Four-by-Four (four-wheel drive and four-wheel steer) 88-L power grader is the smallest in the line. The Super 88 (six-by-six) and the 99-L (four-by-four) graders round out the line. For full data write Austin-Western Works, Construction Equipment Div., Baldwin-Lima-Hamilton Corp., Aurora, Ill., or circle No. 1-1.

Bico-Porter Sieve Shaker

To check aggregate sizes after the bitumen has been extracted from pavement material, an efficient sieve shaker has been announced by Bico, Inc. This shaker makes a screen analysis of the material and classifies it to AASHTO standards. The sieves, which are mounted so that they always tip forward, have a rapid backward-and-forward



Sieve analysis simplified by shakers

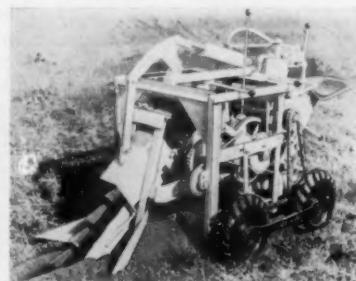
movement which produces two distinct bumps in every cycle. The lighter of these bumps, plus the shaking action, keeps the aggregate stirred up and throws it back and forth across the sieves. The heavy bump serves to force the material through the screen. The motion of the aggregates is constantly cleaning the sieves, minimizing the possibility of clogging. The unit is portable, weighing only 64 pounds, and is built to meet the requirements of continued use either in the laboratory or in the field. Standard equipment includes a 115 AC motor or a gasoline engine. The shaker accommodates six standard eight-inch sieves, together with cover and pan. For further information write Bico Inc., 3116 Valhalla Drive, Burbank, Calif., or circle No. 1-2 on the reply card.

High Lift Utility Boom

A long boom that hands building materials right up to second floor jobs has been developed by Henry Manufacturing. Called the high lift utility boom, it is now available for use with most Henry industrial tractor shovels. Attachments include a material fork and a concrete and mortar hopper with one-third cubic yard capacity. Adjustable in one-foot steps from 11 to 16 feet, it telescopes down into the main support frame. It also can be used for holding steel beams in place for bolting or welding, loading or unloading lumber and for setting up a scaffold. For further information write to the Henry Mfg. Co., 1700 North Clay Street, Topeka, Kans., or circle No. 1-3 on the reply card.

Ditcher For Water and Lawn Sprinkler Systems

The Vermeer Mfg. Co. has announced the new W-2 Pow-R-Ditcher, the smallest of the Vermeer ditchers. The new model has a digging width of 2½ to 4-inches and will cut to a 36-inch depth at a speed of 1 foot to 10 feet per minute. Its over-all length is 10 feet, over-all width 48 inches. The unit stands only 51 inches high and weighs 1100 pounds. The ditcher rides on pneumatic rubber tired wheels and has 4-wheel drive for both digging and transporting. For further details write The Vermeer Mfg. Co., Pella, Iowa, or circle No. 1-4 on the reply card.



Unit has a variety of digging speeds and has a digging width of four inches



Loaders have power steering and four-wheel power brakes



New four-wheel drive Jeep truck for the public works field

New Tractomotive Loader

The TL-20 Tracto-Loader is a completely new 2-cu. yd. front-end wheel loader announced by Tractomotive. Among the features are a complete power shift transmission with torque converter drive which will multiply engine torque up to 350 percent and planetary axles which will provide more rim pull with less strain on the axles, transmission, U-joints, and differential. For safety and handling ease, the TL-20 has power steering and four-wheel power brakes which can be operated by either the right or left foot. A separate positive locking, mechanical parking brake is also provided. Power is by an Allis-Chalmers diesel engine having a 344 cu. in. displacement and developing 95½ hp at 2000 rpm. It has a 24-volt electrical system with an electric starter and an ether dispenser for starting in cold weather; and has three speeds in both forward and reverse. Top speed is 23 mph. The 2-yd. bucket has 40° of tip-back at ground level, and maximum power is transmitted to the bucket through the use of straight line linkage. Dumping clearance is 9 feet. For full details write Tractomotive Corp., Deerfield, Ill., or circle No. 1-5 on the reply card.

Attachment for 3-5 Ton Tandem Roller Features Fast Conversion

A power hydraulic retractable wheel attachment for converting its new 3-5 ton tandem roller to a highly portable unit is being announced by Huber-Warco. Only three steps are required to change

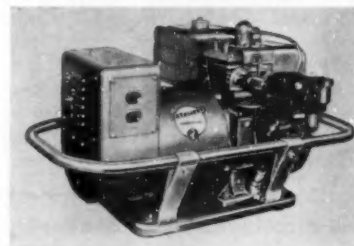


FC-150 "Forward Control" Jeep Truck

A new four-wheel drive truck, the "Forward Control 'Jeep' FC-150," is being introduced by Willys Motors. The all-new FC-150 embodies design and engineering features which provide a vehicle with maximum cargo space in relation to wheelbase. Key to the overall engineering advances is the up-front location of the cab, situated well forward of the engine. This "forward control" design allows maximum usage of the 81-inch wheelbase for pay loads, and places the driver in the best position for all-direction visibility and vehicle control. There are nine forward

and three reverse power combinations. The change from conventional to four-wheel drive is readily made by the single floor-mounted lever without stopping the vehicle. With the tailgate extended, the cargo length is 92 inches. The payload bed is only 24 inches from the ground, for most convenient loading height. Overall length of the vehicle is 147½ inches, and over-all width 58¾ inches, providing maneuverability in close quarters. Turning radius is 18 feet. For more information write Willys Motors, Inc., Toledo 1, Ohio, or circle No. 1-7 on the reply card.

the roller with retractable wheel attachment from its normal rolling position to a travel position for fast movement from job to job. A lock pin is removed and the towing hitch is placed over the pintle hook of the towing vehicle. The hydraulic control on the side of the machine is activated to lower the wheels and raise the guide roll end of the roller. A few turns of a shaft at each wheel locks wheels in position. A second hydraulic lever on the side of the roller is activated to raise the drive roll end of the roller. The towing hitch lock pin is then replaced and the unit is ready to be towed to a new job. The attachment can be supplied already mounted or it may be purchased later and easily mounted in the field. One of the outstanding features of the Huber-Warco 3-5 ton tandem with retractable wheel attachment is balanced weight design which places from 17 to 21 percent less weight on the towing hitch for better towing action at higher speeds. The weight on the towing vehicle is 1,280 pounds. Write Huber-Warco Company, Marion, Ohio, for full details or circle No. 1-6 on the reply card.



1800 RPM Air-Cooled Power Plants

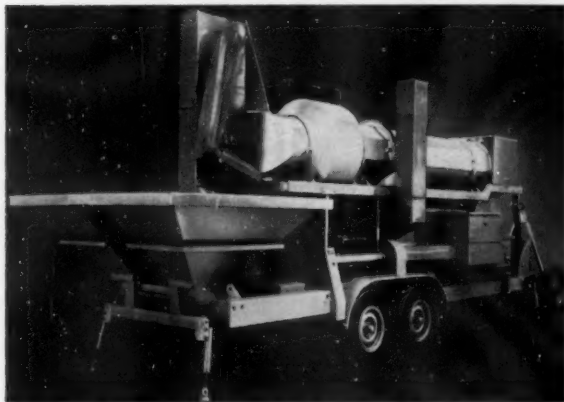
Katolight announces a new series of 1800 RPM air-cooled power plants especially designed for the longer operating requirements. The units are equally adaptable to all types of industrial or emergency applications for portable or stationary use. For the portable applications they can be provided with protective type carrying brackets or wheeled dollies which are easily attached without special tools. The units are available in both manual and electric remote start. All models are driven by Briggs & Stratton four cycle gasoline engines. For complete information, write Katolight Corporation, Mankato, Minn., or circle No. 1-8 on the reply card.

Asbestos Cement Pipe Cutter

A light weight, easy to handle asbestos-cement pipe cutter has been announced by Spring Load. The cutter is quickly adjusted with extensions and bridges to permit cutting oversize pipe. It can cut within one inch of the end of the pipe and gets tight joints everytime with cuts that are square, clean and smooth. For detailed information write Spring Load Mfg. Corp., 3610 First Ave., South, Seattle 4, Wash., or circle No. 1-9 on the reply card.

Mobile Asphalt Plant

The new Wylie Model 1520 Roadmaster asphalt plant is a complete self-contained—fully automatic mobile unit that is ready to operate in minutes. The unit delivers asphalt mix at the rate of 15 to 20 tons per hour. It can be towed and set into position as a stationary plant or moved to a new location by a dump truck. Twin aggregate hoppers hold over a cubic yard of material each, and with the reciprocating plate feeder, the coarse and fine aggregates are fed into the elevator boot. After the aggregate passes through the rotary dryer, it enters a weight-controlled aggregate batcher, and in turn is discharged simultaneously with a required proportion of hot asphalt into the twin-shaft pugmill. Four low-pressure oil burners supply heat for the rotary dryer and the 400-gallon asphalt tank. All thermometers, gauges and control levers are centrally located at the one-man operator position. The "1520" is available with gasoline or diesel engine, and is mounted on six pneumatic tires with stabilizer jacks or on skids as a stationary installation. Complete details from Wylie Manufacturing Co., Inc., P.O. Box 7086, Oklahoma City, Okla., or circle No. 1-10 on the card.



Hot asphalt mix plant that's ready to operate in minutes



Vibration roller for highway building

Self-Propelled Vibration Roller

The ABG Model SW vibration roller weighs four tons, yet gives up to 18 tons of variable compaction with 20-in. penetration. It is powered by an air-cooled, 18-hp Deutz Diesel (serviced in USA.) The roller can climb 25 degrees for truck loading and is thus easily transportable to otherwise inaccessible terrain. For full details write Combined Agencies Corp., Barr Building, Washington 6, D. C., or circle No. 1-11 on the reply card.

Easily Installed Truck Mounted Davis Backhoe

Production of a truck-mounted Davis backhoe is announced by Mid-Western Industries. The low-cost unit will fold and retract on a truck bed for compact transporting and can be removed from the truck in less than five minutes. It will fit virtually any one-ton or larger flat bed truck with no modification of the truck bed. Easily installed or removed, it provides backhoe service for a truck and still permits the truck to be used for other purposes without the unit. In the transport position it has a low silhouette, permitting maximum clearance. In operation the backhoe stabilizer feet absorb the shock with the truck serving as a counterweight. The backhoe is powered by

New Crawler-Loader Introduced

A new crawler-loader with a 30-hp engine and $\frac{5}{8}$ -cu. yd. struck or $\frac{7}{8}$ -cu. yd. heaped bucket is announced by John Deere. The heavy formed-steel loader frame is mounted directly onto the square crossbars of the crawler prime mover making the crawler-loader a unit, and placing the load squarely on both tracks. Bucket break-away lift at ground level is 4,500 pounds. The loader lifts 2,700 pounds to dumping height of 10 feet 6 inches. Steering-brake-clutches make this an extremely maneuverable outfit. A direction reverser allows backward travel in the same speed as forward travel without shifting gears. Two types of flat street shoes, rubber shoes for surfaces that would be damaged by steel, grouser shoes, and two sizes of snow shoes make the machine adaptable to practically all types of operation. For more information write John Deere Industrial Div., Moline, Ill., or check No. 1-12 on the reply card.

any one of a number of suitable industrial engines. The engine is mounted on the truck-attaching kit and is removed whenever the backhoe is. The basic backhoe can be either the standard Model 185 Davis backhoe or the new Model 210 Davis backhoe which is equipped with a new type of rotary hydraulic cylinder that permits a 200° continuous operation arc without ever changing a pin and without the use of cables. Both backhoes have improved comfort design with an extended foot rest and adjustable seat that revolves with the backhoe boom. For full details write Mid-Western Industries, Inc., 1009 South West, Wichita, Kans., or circle No. 1-13 on the reply card.



Backhoe operated from any one-ton or larger flat bed truck



Truck mounted crane-shovel for high-way construction and maintenance work

Power-Crane Shovels

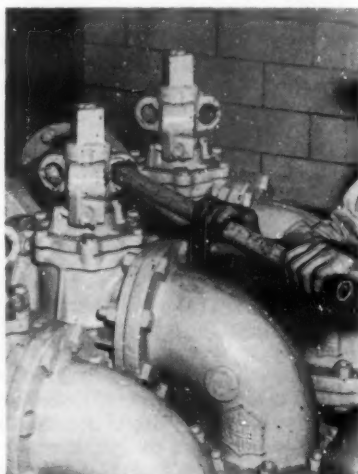
Three new power crane-shovel models have been announced by "Quick-Way" Truck Shovel. One, the Model 85A, is a truck-mounted 0.4-yd., 8½-ton convertible crane-shovel. The Model 105AC is a crawler mounted ½-yd. shovel and the third is the Model 85AC 0.4-yd. crawler mounted shovel. The 85A has complete 360° vision, conveniently grouped controls, instruments and light pressure hydraulic clutch controls that enable the operator to work under comfortable conditions. The entire steel main machinery frame is welded in one piece. The 105AC crawler, equipped with 24-inch cast steel track shoes is available also with 16 and 32-inch shoes. It has speeds in forward and reverse of ⅞ mph in low range and 1¾ mph in high range for greater power and maneuverability. For full information write the "Quick-Way" Truck Shovel Co., P. O. Box 1800, Denver, Colo. or circle No. 1-14 on the reply card.

Portable Bacteriological Laboratory

The Sabro portable laboratory permits accurate and rapid bacteriological analysis by the membrane filter technique. Packed in a compact carrying case, which also acts as an incubator, the unit includes stainless steel filtering apparatus; a vacuum pump; disposable sterile culture cans with dehydrated nutrient pads; bottles for sterile distilled water; reagents; and forceps. As many as 18 samples can be incubated with the temperature controlled within 1°F. The motor providing heat and air circulation operates on 110 volt AC current or on DC current sources. For full details write to Hyla Process Dept., Salem-Brosius, Inc., Box 2222, Pittsburgh 30, Pa., or circle No. 1-15 on the reply card.

Plug Type Valve For Sewage Plants

The problem of valving raw sewage through disposal plant lines is solved by the use of a plug type valve able to withstand sewage corrosion. Designed and manufactured by the DeZurik Shower Co., the plug has a facing of Hycar American rubber, supplied by B. F. Goodrich Chemical Co. The eccentric action of the DeZurik valve swings the plug back and away from the seat to open wide with minimum effort and with no friction from the plug itself. Closing the valve wedges the eccentrically-shaped plug against the eccentrically raised seat, sealing tightly despite intervening solids. Bonded to the metal plug-core, the Hycar facing has the rigidity to close tightly, yet retains the surface resiliency to

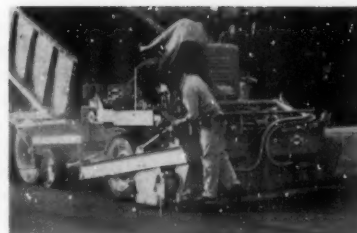


Valve for sewage disposal plant lines

seal around solids which may lodge on the valve seat. This resiliency also resists abrasion from solids in the flow, eliminating scoring on the plug face. Hycar also has high resistance to chemical attack. For further information write G. B. Koch, B. F. Goodrich Chemical Co., 3135 Enclid Ave., Cleveland 15, Ohio, or circle No. 1-16 on the reply card.

Black Top Paver Finisher

A new black top paver finisher for off-the-highway and other use has been announced by Blaw-Knox. The machine has been named the "Black Topper", model PF-45. The unit is 14 feet long and has a base width of 11 feet. It is equipped with two pneumatic tires on the drive wheels. Front wheels under the 4-ton, 10-foot wide hopper are solid rubber tired, two per wheel. The unit is powered by a Continental F-162



Thirty hp engine of the paver gives plenty of "oomph" to push dump truck

gas engine which develops 30 hp at 1,500 rpm; there are six working speeds with a high travel speed of 8 mph. Maximum width of the screed is 11 feet. Sections of the screed can be blocked or removed to pave down to 8-ft. widths. Hydraulic controls lift the screed for 8½-inch clearance. Tamping action is vertical with a speed of 1,000 rpm at 1,300 engine rpm. For more data write Blaw-Knox Co., 300 Sixth Ave., Pittsburgh 22, Pa., or circle No. 1-17 on the reply card.

Photographing Both Sides of a Document at Once

A compact duplex microfilm camera that photographs both sides of a document simultaneously at any of three reduction ratios has been developed by Remington Rand. The Film-a-Record "Model 11" has a 12-inch throat, and doubles 16 mm film capacity by filming up one side and down the other using the 8 mm principle. Readily interchangeable lenses are available for 25 to 1, 35 to 1, and 42 to 1 reduction ratios. Light intensity is adjustable via a single Colorstat control for proper recording of various types and colors of documents. The film capacity is 250 feet of 16 mm film, which can be loaded in daylight. Automatic feeding equipment and a document stacker are available. Further information by writing Remington Rand, 315 Fourth Avenue, New York 10, N. Y., or by circling No. 1-18 on the reply card.



Remington Rand's Film-a-Record



New Case Loader-Backhoe

Built around the Case 310 utility tractor the new front-end loader and backhoe combination is a heavy-duty-rubber-tired unit. The backhoe with a full 180° swing of the boom, 18-ft. 2-in. reach, and 12½-ft. digging depth is ideal for construction or maintenance work. The dumping reach of 11-ft. 1-in. permits end loading of trucks. If necessary, the backhoe can be disconnected in minutes, freeing the tractor for other duties. For full details write J. I. Case Co., Racine, Wisc. or circle No. 1-19 on the card.

Vacuum Tube Millivoltmeter

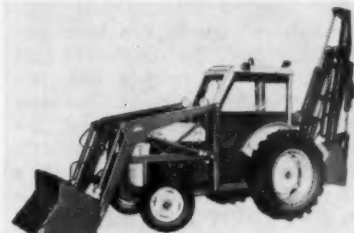
Direct, accurate, in-the-field, measurements of very small potentials are easily and quickly made with this new battery operated vacuum tube millivoltmeter. Mounted in a leather carrying case,



it is specifically designed for field measurements of small potentials associated with corrosion problems and electrochemical and biological tests. Essentially infinite input resistance, 10 megohms, on all ranges provides minimum disturbance to the circuit under test. Six full-scale ranges between 0-25 and 0-1000 millivolts and two additional ranges, 0-10 and 0-100 volts, are provided. Scale divisions are divided on the 0-25 millivolt scale so that measurements to 50 microvolts are possible. It is available in both DC and AC models and weighs 5 pounds. For further information contact Fisher Research Laboratory, Inc., 1961 University Avenue, Palo Alto, Calif., or circle No. 1-20 on the reply card.

Northeast Cab Is Custom Built For Popular Make Tractors

A rugged, all-weather cab for most popular makes of industrial tractors is announced by Northeast Equipment. The cab is quickly and easily installed on Ford, Fordson Diesel, IHC, Ferguson, Oliver "55", Sherman fork lifts, Terratrak and



Cab is custom built for most makes of tractors and can be quickly installed

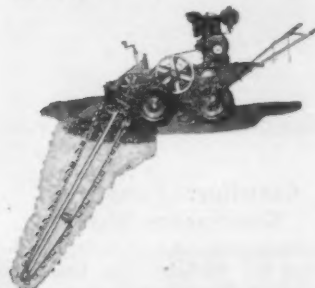
John Deere tractors. The cabs are custom built for each model of tractor and are made to fit snugly. Heavy gauge steel top and supports insure long life; heavy-duty canvas side and rear panels provide protection in bad weather and can be easily removed or rolled up for summer use. With safety glass windshield and skylight and heavy Vinyl windows, the cab has full visibility in all directions. For full details write Northeast Equipment, Inc., Brookfield Street, Worcester, Mass., or circle No. 1-21 on the reply card.

Versa-Tester A Fast and Accurate Laboratory Compression Testing Machine

A new multi-purpose compression testing machine, the Versa-Tester, has been announced by Soiltest. The testing machine is designed for routine and research compression and flexure testing of such materials as soils, asphalt, mortar, concrete, plastics, metals and wood. It has a load capacity of 30,000 pounds and is accurate to within 1 percent of the indicated load. The working mechanism is enclosed in a grey steel cabinet. Front and back panels are easily removed for access to the working parts. Two handily placed controls make it easy for the engineer to operate and adjust the machine. Maximum specimen clearances are 12 inches wide by 18 inches high allowing a wide range in specimen sizes. The machine requires a floor space of only 28 by 24 inches. The overall height is 72 inches. The loading rate is adjustable up to 6 inches per minute. For more details write Soiltest Inc., 4711 W. North Ave., Chicago 39, Ill., or circle No. 1-22 on the reply card.

Low Cost Trencher Saves Time and Labor

A one-man operated trencher for water lines, sprinkling systems, basement out-lines, garage foundations, and hundreds of other uses is announced by Brown Manufacturing. Mounted on rubber, it will not damage lawns and is highly portable. Cuts trenches 3 in. wide up to 5½ ft. deep; 4 in. wide to 3½ ft. deep; and 6 in. wide to 2½ ft. deep.



Trencher powers itself from one place to another and on to any pickup truck

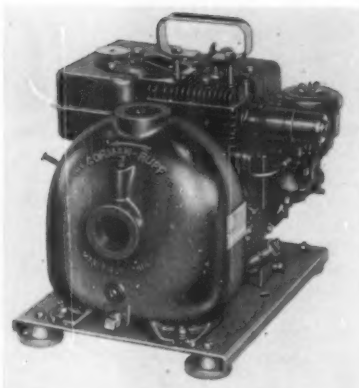
All moving parts subjected to dirt are mounted on sealed bearings. For complete information, write Brown Manufacturing, Inc., Dept. BT, Woodbine, Iowa, or circle No. 1-23.

Self-Propelled Spreader

A new self-propelled "Spread-Master" power spreader has been announced by Flaherty Mfg. The spreader has a 57-hp gasoline engine tractor with 1300 rpm. It has 5 forward and 5 reverse speeds with midship shuttle gear transmission. A 13-ft. spread hopper of storage capacity is provided making possible a continuous spread. It has easily adjusted cut-off gates, permitting spread widths of from 6 inches up. A four directional screw type agitator, eliminating segregation of cover materials, and a grizzly with a 1-in. opening that retains all over-size and foreign objects, are features. For more information write Flaherty Mfg. Inc., P. O. Box 1042, Pocatello, Idaho, or circle No. 1-24 on the reply card.



Power spreader for highway work



Gorman-Rupp "Series 80" pump

Centrifugal Pumps For Construction Work

A complete line of pumps, the "Series 80" self-priming, has been introduced by Gorman-Rupp. The new design eliminates the check valve and features straight-in suction with the pumped liquid entering directly at the eye of the impeller. The design of the "Series 80" assures freedom from pumping failure under all operating conditions. Available with base or wheel

mounts, the pumps are driven either by engine or motor. They are available from 1½" to 8" sizes. Detailed specifications of models may be obtained from The Gorman-Rupp Co., Mansfield, Ohio, or circle No. 1-25.

IHC "All-Wheel-Drive" Trucks

The line of International "all-wheel-drive" trucks has been expanded through the addition of four six-wheel drive models and two four-wheel-drive models. The new six-wheel-drive models are the SF-170 (6x6), with gross vehicle weight rating of 22,000 pounds; SF-172 (6x6), GVW 26,000 pounds; SF-180 (6x6), GVW 30,000 pounds; and SF-182 (6x6) GVW 33,000 pounds. New four-wheel-drive models are the S-170 (4x4) GVW 19,000 lbs.; and S-180 (4x4), GVW 20,000 pounds. The trucks are designed for off-highway operation where heavy loads or equipment are to be moved over terrain requiring greater traction. Standard rear-end loading height and minimum increase in front-end height with excellent ground clearance are design features of the new models. Full torque power take-off mounted on the



International SF-170 heavy duty truck

transfer case is available for use with each of the new models. For full details write Consumer Relations Dept., International Harvester Co., 180 North Michigan Ave., Chicago 1, Ill., or circle No. 1-27 on the reply card.

Portable Trail-O-Dryer And Dual Feeder Bin

The combination dryer-bin unit announced by Littleford is intended to fill the needs of road builders and road maintenance men for a small low cost aggregate dryer. The new dryer and bin combination will feed hot pre-mixed dry material to a Littleford Model 700 Trail-O-Patcher. The Trail-O-Patcher mixes the aggregate and asphalt together for discharge of "black-top" material directly into trucks without rehandling. The Trail-O-Dryer can be used for low cost drying of sand and aggregate for any use. The dryer has a capacity of 15 tons per hour based on removal of 5 percent free moisture and at 310°F discharge. It will produce up to 25 tons per hour when drying aggregate for stock pile mixes or when moisture content is very low. The dryer is equipped with a Wisconsin TF-D 12.5 hp @ 2000 rpm two-cylinder gasoline engine and a low pressure air-atomizing type burner

Tractor Shovel Loads 25-Yd Truck in Four Passes

A new 6-cubic yard capacity "Michigan" tractor shovel has been developed by Clark Equipment to provide low cost high speed loading. Known as the Model 375A, the tractor shovel weighing over 50,000 pounds, is equipped with a Cummins turbo-charged 335-hp diesel engine. It will lift 30,000 pounds while stationary and carry 15,000 pounds at 4 mph. Also available is a tractor

shovel with capacity of 4 cubic yards, known as the "Michigan" Model 275A. Each machine has four speeds forward and four speeds reverse, and a top speed of 28 mph. Full power shift with two finger-tip control levers on steering column is standard equipment on both models. For more details write Clark Equipment Co., Pipestone Rd., Benton Harbor, Mich., or circle No. 1-26.



Power steering and wide base, tubeless tires are standard



Hot mix plant with dual bin feeder and a portable dryer

with a capacity of 7 to 40 gph. The elevator on the dryer has a standard 10-ft. discharge height, but additional 2 and 4-ft. sections can be added to increase discharge height. The Littleford Model 5T25 dual feeder bin has a capacity of 5 tons; a division in the bin provides for two 2½-ton compartments. Two separate, fully-adjustable gates permit variable proportioning of two different aggregates. A reciprocating feeder is designed to discharge directly into the inlet end of the dryer thus eliminating the requirement of a cold elevator between the bin and the dryer. For more details write Littleford Bros., Inc., 443-457 East Pearl St., Cincinnati 2, Ohio, or circle No. 1-28 on the reply card.

Wet-Mix Pneumatic Concrete Machine Increases Production

True Gun-All Equipment Corp. has announced a new model of a wet-mix pneumatic concrete machine. The "DC" model increases production considerably because of a mixing and loading device being



Machine pre-mixes the aggregate and cement, no sand dryer is required as sand of any moisture content is used

added to the unit itself. Up to five cu. yds. of concrete per hour can be placed with the unit by a five-man team. It pre-mixes dry aggregate and cement, then loads the mix into twin tanks where hydration and re-mixing occur before the resultant concrete is shot into place. Controlled quantities of the aggregate and cement are introduced alternately into the 7-cu. ft. mixing chambers; then the exact amount of water required for the batch is measured in by a metering device. The material is then mixed and blown through a hose, the nozzle-man applying the material on the surface to be covered. For further information write True Gun-All Equipment, Post Office Box 2526, Tulsa, Okla., or circle No. 1-29.

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Unusual opportunity for graduate Civil Engineer or equivalent with professional license in southern Pennsylvania city. Experience essential in: surveying, street and sewer design and construction and related municipal work. Experience desirable in zoning and subdivision control. No structural design is involved. Would be in charge of Engineering Department, supervise survey crew and draftsman, and would be expected to meet the public as required. Salary range \$7,000 to \$8,500 with usual benefits. Permanent non-political position. Send resume of training and experience to:

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100 South Second Street
Chambersburg, Penn.
Attention: Mr. J. G. Cree

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The City of Winter Park, Florida, is seeking a City Engineer. Must have engineering degree and three years' experience in Civil and Sanitary Engineering. If accepted must obtain Florida registration. Salary \$7,200. Opportunity to live in Florida. Address application to:

City Manager
Winter Park,
Florida

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CIVIL ENGINEER, minimum 5 years experience municipal design, supervision and administration. Eligible for Florida registration.

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Tractor with backhoe and loader at work on a road project

M-M Crawler and Industrial Tractors

New crawler and industrial tractors have been announced by Minneapolis-Moline. The major engineering features of the crawler tractor include: A 206-cu. in. engine; mono-weld main frame with rubber mounting points; shuttle gear with 6 speeds forward and 6 reverse, hydraulically operated; and a torque converter available as optional equipment. The engineering features of the 335 and 445 industrial wheelers, and the 445 utility tractor include: a 206-cu. in. (445) and 165-cu. in.

(335) high-turbulence, valve-in-head engines. They also have the MM exclusive removable cylinder heads and blocks cast in pairs; rigid, single-unit crankcase and basepan construction; side plates for easy access for maintenance and dual-range transmission with 10 speeds forward and two reverse. Attachments available for these tractors include loaders, backhoes, dozers, mowers, blades and compressors. For more data write Minneapolis-Moline Co., Box 1050, Minneapolis 1, Minn., or circle No. 1-30.

Portable Direct-Reading Dissolved Oxygen Analyzer

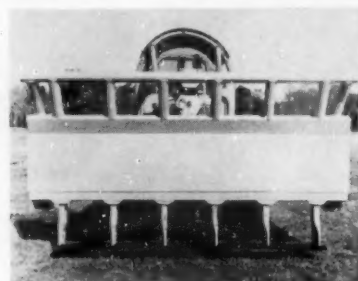
A portable dissolved oxygen analyzer which operates as simply as a modern pH meter has been developed by Dorber Co. The instrument, an amperometric type, employs a rotating platinum electrode with a unique, stable electronic system which automatically translates diffusion current into units of dissolved oxygen concentration. The instrument determines

dissolved oxygen from 0 to 10 ppm within 5 percent of the true value for most aqueous solutions. It can also be operated in the laboratory with 115 volts AC and is not affected by power line voltage fluctuations. An important feature is that it is not subject to interference by dissolved iron, calcium, magnesium, sulfides, nitrites, or organic matter. Samples can be colored or turbid. Further information from Dorber Co., 7741 W. Palatine Ave., Chicago 31, Ill., or circle No. 1-31 on the reply card.

Speed Clearing Capacity of Crawler Tractors With These Attachments

The Fleco D9 rake built for the Cat D9 tractor stands more than 6 ft. high and 14 ft. wide and is designed to push out trees, brush and stumps and rake material into dirt-free piles. Another Fleco development is the rake for the Cat No. 977 Traxcavators. This fits on the lift arms of the Traxcavator, taking the place of the bucket. Teeth are curved to carry a maximum load, and to lift a big pile of brush, stumps or limbs off the ground and

stack the material in high piles. A Cat D7 tractor equipped with a Fleco treecutter, slices off trees up to 14 inches at ground level. The Fleco heavy-duty cab guard gives added protection to the operator from falling branches. Mounted at the rear of the D7, the Fleco pull stumper is operated independently

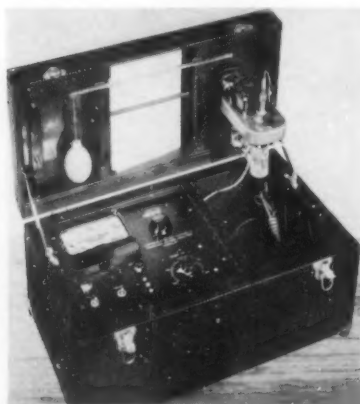
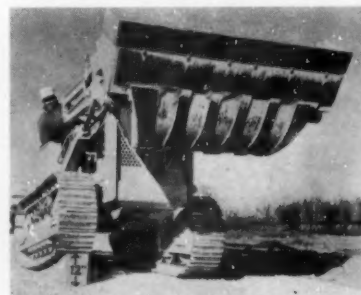


Fleco land clearer mounted on Cat D7

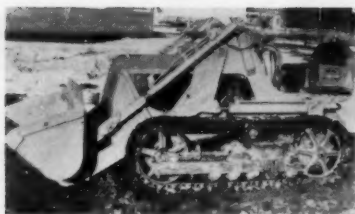
of front mounted equipment on tractors equipped with double drum cable control units. For more details write Fleco Corp., Jacksonville, Florida or circle No. 1-32 on the reply card.

Crawler-Loaders For Construction and Maintenance Work

Two new TerraTrac crawler-loaders, in the 1½ to 2-yd. range, have been announced by American Tractor. The machines incorporate a number of engineering advances, including a new power-shift transmission, which provides completely independent power control of each track, both as to speed and direction. A new torsion bar track suspension, designed to insure complete equalization and cushioning of loads, enables the loaders to maintain a level cut with full traction on both tracks, regardless of irregularities in the ground surface. Both loaders have a dumping clearance of over 9 ft. with bucket fully dumped, plus "knock-out" action for discharging sticky materials at all heights—from 31 inches up to a maximum dumping height. For complete specifications write American Tractor Corp., Churubusco (Ft. Wayne), Ind., or circle No. 1-33.



Instrument valuable in testing sewage and waste waters for dissolved oxygen

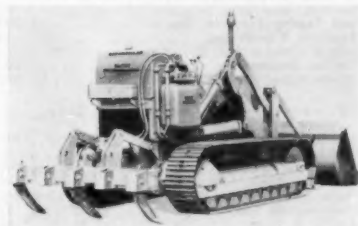


Bucket "rolls back" a full 40 degrees

Teale Loader For Cat D-2's

A new model TL-21 loader for the Cat D-2 has been announced by Teale. The TL-21 will lift a heaped 7/8-yd. bucket to a full 9-ft. 10-in. height (at bucket hinge points) in about 6 seconds. Careful design has cut seconds from the loading cycle by speeding both loading and dumping. A new, heavy-duty, "Ram-Fill" bucket loads faster and "rolls back" a full 40 degrees at ground level for fuller loads. Then "roll-action" pry-out with 8500 lbs. of power assures fast, smooth break-away. When the self-leveling bucket reaches full height, the "deep-angle" dump and "positive" banging action help dump wet, sticky material quickly. In addition, design permits digging 9 inches below ground level. For full information write Teale & Co., Box 308, Omaha 1, Nebr., or circle No. 1-34 on the reply card.

Tractor Mounted Rippers

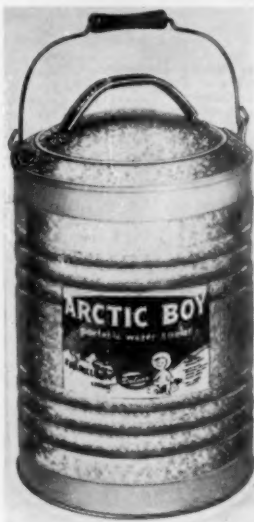


Two new tractor-mounted rippers designed to speed bulldozing and loading operations have been announced by Caterpillar. The largest of the rippers, the No. 6 ripper, is for use on the Cat No. 977 Traxcavator and Cat D6 tractor. The smaller model, No. 4 ripper, is for use on the Cat No. 955 Traxcavator. Three alloy steel teeth with replaceable tips are normally installed, but provision has been made for the installation of two additional teeth, should they be desired. The new rippers are rugged enough to permit the full power of the tractor to be absorbed by one tooth at maximum penetration. A design feature of the rippers is the parallel linkage which is used to maintain the same angle of penetration at all depths. For full data

write Caterpillar Tractor Co., Peoria, Ill., or circle No. 1-35 on the reply card.

Portable Water Coolers

The Arctic Boy line of water cans and coolers, with hot dipped galvanized insets, is announced by Schleuter. The inset of every can and cooler is sprayed with "Sparkleen" Liner, which is a chemical substance that is baked on with infra-red lights. This liner will keep



the interior of the containers clean for the lifetime of the can and will keep beverages odor free and taste free. These coolers are available in two, three, five, ten and fifteen-gallon sizes in both the standard weight and heavy duty models. For more details write Schleuter Mfg. Co., St. Louis 7, Mo., or circle No. 1-36.

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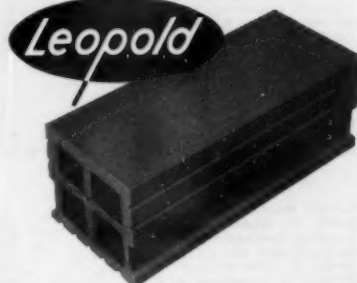
PACIFIC NORTHWEST Industrial Waste Conference dates have been set for April 4 and 5, at Washington State College, Pullman. Further information from the Technical Extension Service of the College.

LOUISIANA WATER and Sewerage Short Course for Superintendents and operators will be held at Pleasant Hall, Louisiana State University, Baton Rouge, March 20-22. Geo. H. West, Secretary, Box 15, Lake Charles, La.

JAMES M. SYMONS has been appointed an Instructor in Sanitary Engineering at MIT. He is a son of "Doc" Symons, well and favorably known in the broad field of sanitary engineering.

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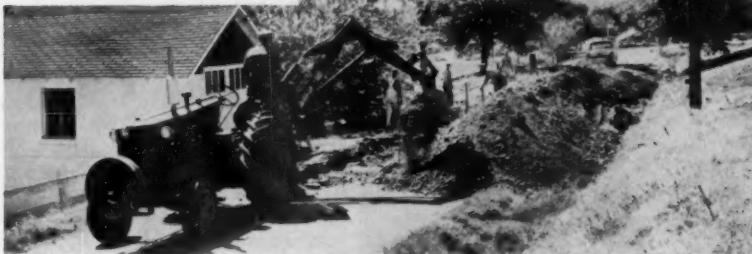
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-Worth Seeing

More argument for machines over men (even if you could get the men) is shown in this City of Columbia, Tennessee, job where an International 400 utility tractor powers an Ottawa backhoe to trench through stubborn clay and blast rock material at the rate of 150 feet per 7-hour day. An 8-inch vitrified clay pipe sewer will be placed in the 4,000-foot long, 24-inch wide, by 10-foot deep trench being dug.



Bring order out of chaos. An International Drott TD-9 4-in-1 Skid-Shovel is transforming a 15-year old dump at Claremont, N. H., into a modern sanitary landfill. The unit spreads refuse, crushes it and spreads a dirt covering over it on the four-acre disposal site.

Photographic proof that the Big Push is on in the new 41,000-mile Interstate highway program. Here dual paving trains of the Koss Construction Co., Pauline, Kansas, begin placing pavement on the first link, for U. S. Route 4, west of Topeka. It is believed to be the first constructed from the new \$25 billion funds provided in the 1956 Highway Act. These highways are designed for traffic loads of 1975, and constructed to last for 50 years. Photo courtesy Portland Cement Association.



There would not be standing room for all the pick-and-shovel workers who once would have been required to do what this Bucyrus-Erie ¾-yd. backhoe is doing as it trenches through clay for the installation of a municipal sewer line along a road in Henrico County outside of Richmond, Virginia.

Repair street cuts*



* **EASIER**... the JAY TAMPER is a rugged, portable, complete unit in itself—no cumbersome auxiliary equipment needed.

* **FASTER**... the JAY TAMPER is self-propelled... easily handled by one man. Compacts up to 60 feet per minute. Operates in ditches... next to obstacles... anywhere you want it to go. It's the most practical tamper ever built!

* **BETTER**... impact and vibratory action of the JAY TAMPER keyseats any type of fill to uniform Proctor density, preparing a solid foundation for any purpose.

Write for complete information or investigate the Jay Tamper at your equipment dealer.

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JAY better tamp it!



WORTH TELLING

by Arthur K. Akers

★ **OUR CRYSTAL BALL** says that 1957 will be a very good year for smart people. Since all readers of this column are that, we can safely wish you all a Happy, Prosperous and Satisfying New Year!

★ **NATIONAL SLAG ASSOCIATION**, Washington, elected A. W. Wood, president Lorain Slag Co., president; C. W. Ireland, president Birmingham Slag Co., vice president; and continued E. W. Bauman as managing director.

★ **THE PORTLAND CEMENT ASSOCIATION**, Chicago, will construct two new laboratory buildings in Skokie, Ill.; one for fire research, one for structural development.

★ **BUFFALO-SPRINGFIELD** Roller Co., one of the oldest in the business, merged on December 1 with Koehring Co., of Milwaukee, to be operated as a division of the latter. E. S. McCormick will be the



Mr. Harrison



Mr. McCormick

BSR general sales manager, John F. Harrison continues as vice president and general manager.

★ **B-I-F INDUSTRIES**, Providence, names Leon H. Chamberlain, district engineer for water and sewage sales for the entire West Coast. Frank D. Brindel becomes manager of B-I-F Pacific Division at Berkeley, Calif., and Paul V. Hennessy manager of Los Angeles office.

★ **ARTHUR C. FRANK** is new assistant sales manager, J. H. Holan Corporation, Cleveland.

★ **PUSHED** to keep up with demand for its filter bottoms, butterfly valves and other water works and sewage equipment, F. B. Leopold



Co., formerly in Pittsburgh, has moved into this modern new building in near-by Zelienople, Pa.

★ **A. C. ADAMS** is named advertising manager, Wallace & Tiernan Co., Belleville, N.J. in place of O. S. Porter, promoted to other duties.

★ **RANNEY METHOD** Water Supplies Inc., Columbus, Ohio, has formed the S. G. Allen Construction Division, general contractors for waste disposal, water works and allied activities.

★ **LINK-BELT CO.** will build a new plant at Montebello, Calif., to replace and expand its downtown Los Angeles facilities.

★ **AMERICAN WELL WORKS**, Aurora, Ill., appoints Gerald A. Fleet, manufacturers' representative, White Plains, N.Y., as New York area district sales representative.

★ **IF** you want to go to Puerto Rico in May, remember the Inter-American Congress of Sanitary Engineering there on the 18th through 24th. There will be exhibits, and President J. A. Frank of the Water and Sewage Works Manufacturers Association, New York 38, is promoting attendance to all those interested in doing business in Latin and South America.

★ **MEN** still die with their boots on, but one boot is often on the accelerator.

—Carolina Highways

For Columbus' new expansion to 120 mgd....

Plant Manager, James H. Blodgett, and Uhlmann Associates, consulting engineers, faced tough problems in doubling the capacity of a previously expanded activated-sludge plant.

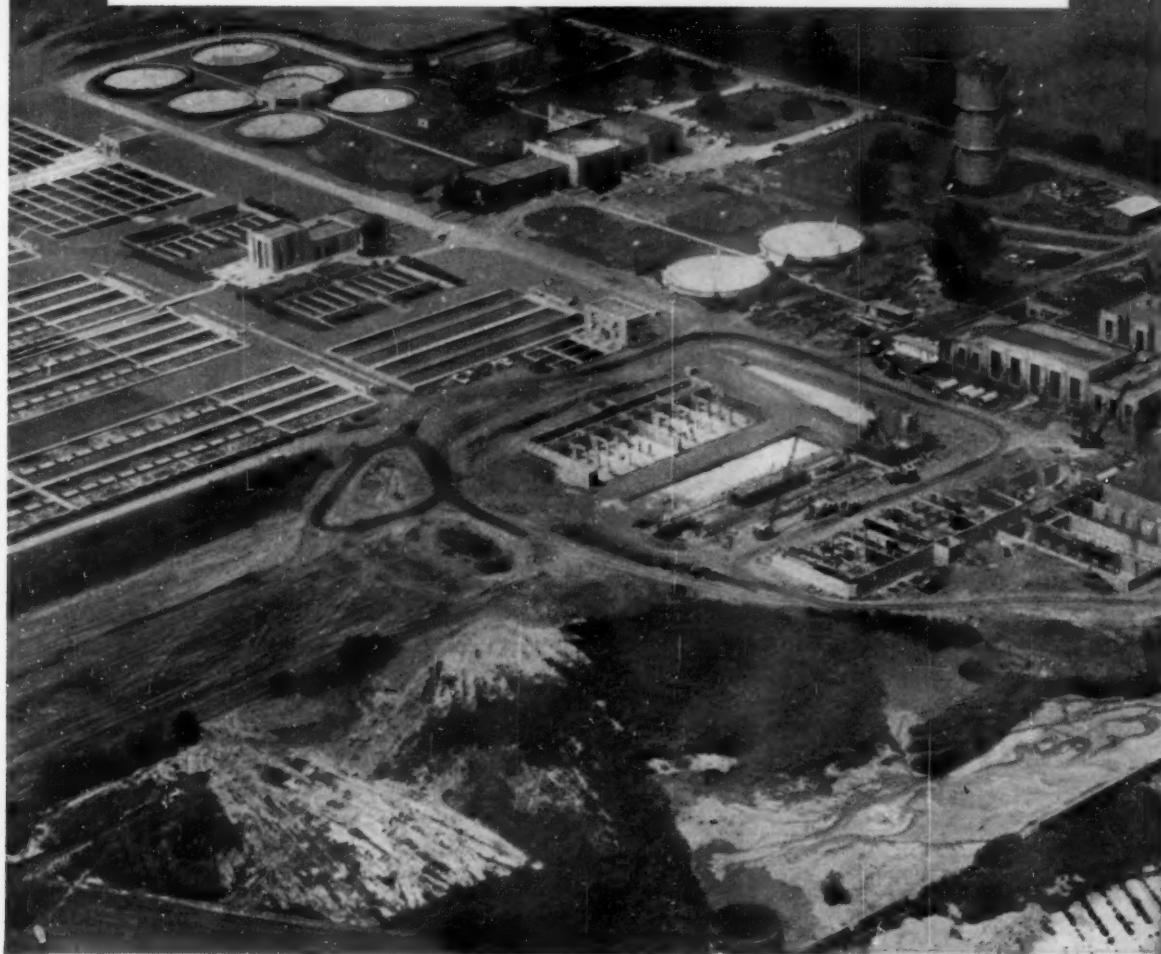
To get top plant performance, the complex instrumentation—both old and new—would have to be pulled together. Twenty year old meters would have to be modified, rebuilt, or replaced to work alongside today's improved models, telemetering total influent for the entire expanded plant to one central control point.

Here's why Simplex was selected to solve these problems. Simplex redesigned and will rebuild the old venturi tube receivers to perform dependably and accurately alongside the newest venturi tubes and

meters—specially engineered by Simplex to Columbus' exact requirements. From this integrated system of old and new units spread over a big plant area, Simplex Orthoflow® will *electrically* transmit vital influent data to one central control point—instantly, accurately.

Your Plant. We'll gladly help you in expanding your old plant or planning a new one. Write today outlining your problem. Simplex Valve & Meter Company, Dept. PW-1, 7 East Orange Street, Lancaster, Pa.

SIMPLEX®
VALVE AND METER COMPANY



WALLACE & TIERNAN



A-711 V-notch Chlorinator has rotameter indicator with 10 to 1 feed range



A-712 V-notch Chlorinator has dial indicator with 20 to 1 feed range

NEW

V-notch Chlorinators **SIMPLIFY** *Chlorination*

With the new Wallace & Tiernan V-notch Variable-Orifice Chlorinators:

OPERATION IS SIMPLIFIED as one injector control starts or stops the unit. Chlorine gas is turned on or off automatically.

SETTING FEED RATE IS SIMPLIFIED as one control sets feed rate precisely at both high or low feeds.

INSTALLATION IS SIMPLIFIED as units are

shipped ready for operation. No water supply is needed at the chlorinator. A remote injector uses only standard water supply fittings.

MAINTENANCE IS SIMPLIFIED and virtually eliminated. All parts are corrosion resistant, mounted in an attractive modern cabinet.

For full details on manual or automatic proportional V-notch Chlorinators, contact your W&T representative, or write to the address below.

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